HEALTH BUILDING NOTE 6

Mc0063

Radiodiagnostic Department

DEPARTMENT OF HEALTH AND SOCIAL SECURITY
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Health Building Notes

Health Building Notes are intended for use in the briefing and design stages of projects to assist those concerned with the provision and design of new health buildings and the adaptation or extension of existing premises. The Notes contain information on the relevant aspects of current policy, the functional requirements and resultant design implications. Their objective is to provide standards of accommodation that are economically consistent with the functional requirements and a Departmental Cost Allowance that is directly related to these standards.

A flexible approach is adopted in the Notes. Optional solutions with cost implications are indicated, where appropriate, leaving local planners to make their own choice, having regard to overall cost limits. The general approach is to identify functions, activities, equipment needs and those dimensions which are critical to the efficient performance of an activity, but not to relate functions to specific or preconceived floor areas.

Reference is made in the Note to Activity Data sheets which provide the detailed user requirements for each room or space.

Guidance on those spaces that commonly occur in health buildings has been brought together in a Health Building Note, No.40 entitled 'Common Activity Spaces', to which reference is made, where appropriate, in each Note. At the time of writing a draft of the 'Common Activity Spaces' document has been made available to NHS Authorities.*

The Notes are prepared in consultation with representatives from the NHS and appropriate professional bodies concerned with, or having a specific interest in, their content.

* Common Activity Spaces, HBN 40,
Volume 1 — Clinical, Sanitary, Administrative and Associated Spaces
Volume 2 — Corridors

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1 General considerations

Introduction

1.1 This Health Building Note supersedes Hospital Building Note 6 'Diagnostic X-ray Department' published in 1961 and revised in 1968.

1.2 For many years there has been an increasing demand for radiological and associated diagnostic examinations and it is not anticipated that this trend will change in the near future. Technological advances and innovations in imaging may produce changes in radiological practice but it is unlikely that these will significantly affect the need for conventional X-ray examinations. A well designed radiological department is essential if patients are to be investigated speedily and efficiently. Diagnostic X-ray services in association with other diagnostic imaging services play a crucial role in the investigation of disease.

1.3 This Note provides guidance which covers a wide range of design options; the most effective use of the Note depends on full, early and continuing consultation with future users of the department.

Inclusions

1.4 Guidance is given on the planning and design of radiodiagnostic departments for a District service where the normal range of radiological and related procedures in routine use at general acute hospitals are to be employed.

Exclusions

1.5 This Note does not give guidance on:

a. the planning of rooms for highly specialised complex radiological procedures which are more appropriate to specialised units, eg regional cardio-thoracic and neurosurgical centres;

b. the accommodation requirements for computerised tomography for brain or whole-body scanning (Appendices I and II); [guidance on this subject will be forthcoming]

c. Teaching Facilities. A separate case will need to be made for the cost of any additional accommodation needed for trainee radiologists or radiography students. (See the Department's DS letter 65/74 about teaching hospital space requirements issued on 22 March 1974);

d. Radioisotope Services. Information on these services is contained in 'Radioisotope Services—A Design Guide' DHSS 1973 [to be revised]. This document can be used as appropriate when, in accordance with local decisions, some facilities for radioisotope services are to be included in the radiodiagnostic departments. Information on premises and equipment for the preparation of radiopharmaceuticals is included in Health Building Note No.29, 'Pharmaceutical Department' (in preparation) and also in the 'Guide to Good Pharmaceutical Manufacturing Practice', HMSO.

Purpose of the department

1.6 The purpose of a radiodiagnostic department is to provide facilities for the investigation of patients by means of radiological and complementary techniques. These investigations are normally undertaken at the request of the clinician responsible for the patient concerned, modified if necessary by a radiologist. Radiodiagnostic departments seek to provide diagnostic information by carrying out investigations and reporting on the results as quickly as is reasonably practicable.

Range of provision

1.7 The facilities referred to in this Note reflect current policies in radiology. New space requirements arising from such policies and the development of new techniques have been provided for as economically as possible. The Departmental Cost Allowances reflect the new provisions. (Chapter 6) The Note stresses the need for flexibility in the use of all diagnostic rooms which should be suitable for a range of diagnostic procedures including ultrasound.

1.8 All diagnostic rooms should preferably have natural lighting and be mechanically ventilated with options for air cooling in fluoroscopy/special procedures rooms. Gas scavenging should be provided for in the special procedures rooms, as it is envisaged that general anaesthetics will routinely be given only in these rooms. From time to time diagnostic equipment has to be replaced. Appendix VI discusses various methods for the construction of floors to minimise disruption to the smooth running of the department. To allow for flexibility in the provision of ceiling-mounted diagnostic equipment a structural, modular steel grid is recommended. (4.26)

1.9 The size of the current film store takes into account the increased demand. Recognition has also been given to the importance of sorting and collating films and reports and an area has now been provided for this purpose.

1.10 The use of daylight automatic processing is recommended in this Note, although every department should have at least one processor associated with a darkroom in order to deal with non-standard processing requirements. Daylight systems offer considerable potential for improving working conditions and are efficient and cost effective.

1.11 The Note also refers to facilities which will be required within the hospital, but whose location is dependent on whole hospital policies. The seminar room and workshop have therefore been costed separately.

Range of techniques

1.12 Most of the work undertaken in a radiodiagnostic department makes use of X-rays but many departments also carry out ultrasound investigations and other forms of imaging. The building implications of such techniques need to be understood by those involved in designing departments so that facilities can be planned to meet the needs of patients and staff. To assist project teams descriptions of a range of radiological techniques are given in Appendix I.

Sources of work

1.13 Radiodiagnostic departments in a hospital provide a diagnostic service for other departments in the same hospital, smaller neighbouring hospitals, general practitioners and community health team doctors.

Diagnostic work outside the department

1.14 Investigations may take place outside of the main radiodiagnostic department and possibly in associated smaller hospitals. In such cases the radiodiagnostic department may provide staff and will be responsible for the radiological equipment used.

2 Planning aspects

2.1 A consultant radiologist, an experienced radiographer with expertise in radiological practice and procedures, and a radiological engineer experienced in the provision and installation of radiological equipment should be involved with the project team from the beginning and throughout the continuing stages of the project.

2.2 Due to the continuing modification of imaging equipment and the development of new equipment (see Health Equipment Note 6) it is advisable to leave the selection of equipment for diagnostic rooms as late as possible. Consequently, it is not feasible at the design stage, or indeed early building stage, to select the particular equipment to be installed. It is therefore recommended that provision should be included in the contract for the cost of pre-installation work and that the fitting-out of the rooms in preparation for the installation of equipment should be left as late as is practicable. The Regional radiological engineer is usually responsible for providing information on the installation of equipment and will work closely with the pre-installation planning department of equipment manufacturers.

Note: The Departmental Cost Allowance for fitting-out a room includes Group 1 equipment which is normally supplied and installed as part of the building contract.

Environment

2.3 Good interior design can contribute to good staff morale and making patients feel at ease. The aim should be to create a pleasant and cheerful environment throughout the department within the constraints of clinical requirements. Natural ventilation and natural or borrowed light from adjacent spaces should be provided whenever the building form and clinical considerations permit.

2.4 Patients' main waiting and sub-waiting areas should be comfortable and have tasteful colour schemes. The design should reflect the need to preserve the dignity and privacy of patients, particularly where men and women are examined in adjacent areas or share certain accommodation and circulation spaces. There should be auditory privacy where the function carried out in a space requires it.

2.5 Diagnostic rooms have complex functional requirements but they should be designed to present as orderly an appearance as possible. Attention should be given to heat generated by equipment and its effect during certain special procedures which can create working conditions that are extremely uncomfortable for staff.

Internal spaces

2.6 Internal rooms may contribute to economy in planning but the resultant additional artificial lighting and ventilation which may be necessary will add to both capital and running costs; such rooms are not conducive to good working conditions and should be limited to supporting service rooms or those spaces which are either infrequently occupied or demand a controlled environment. Rooms which are likely to be occupied for any length of time by staff or patients should have windows. Staff may be difficult to retain if office areas do not have a view to the outside.

Courtyards

2.7 Courtyards will enable more rooms to receive natural daylight and ventilation. Skilled design and intensive planting appropriate to the micro-climate can provide a stimulating outlook from patients' areas and from staff areas which will compensate for the lack of a longer view. Privacy in surrounding rooms can be preserved by suitable layout and planting. Ground cover planting is often more successful than grass and is easier to maintain.

2.8 It is desirable to provide access to courtyards wherever possible; thresholds should be designed to facilitate the passage of wheelchairs; seating should be provided. Access for maintenance should be from a hospital street or other corridor so that patients and staff are not disturbed. Adequate services should be provided in all courtyards for irrigation, power and perhaps lighting.

Note: Reference should be made to HBN 45 'External Works' for more detailed guidance on this subject. (In preparation)

Radiation protection

2.9 Authoritative advice on radiation protection and on the interpretation of relevant publications must be obtained from the Radiation Protection Adviser to the Health Authority who should be consulted at the outset and then as necessary throughout the project. Advice on radiation protection is also available from the National Radiological Protection Board, Chilton, Didcot, Oxfordshire OX11 0RQ. The relevant documents available currently from the Department of Health and Social Security, Health and Safety Executive and the National Radiological Protection Board are given in the list of references. These documents will have important consequences for the design of the radiodiagnostic department and the installation of radiology equipment. Project teams should also contact the local representative of the HSE inspectorate at an early stage.

2.10 To ensure that radiodiagnostic rooms incorporate appropriate shielding for all persons outside the rooms, the choice of constructional materials for floors, ceilings and walls (including windows and doors) must be agreed with the Radiation Protection Adviser.

Radiation Hazard/Warning Signs

2.11 Illuminated warning signs, in accordance with the guidance mentioned above, must be provided at each entrance to every radiodiagnostic room. The Radiation Protection Adviser should be consulted over their siting and examples can be seen in the Department's signposting manual, HTM 65 'Health Signs'.

Size of the department

2.12 In planning a radiodiagnostic department its size should be expressed in terms of the number of diagnostic rooms, irrespective of their use. To avoid initial over-provision the department should be designed and located to permit phased expansion, care being taken to ensure that each phase is viable within itself and that the department will function as a complete entity regardless of its size.

2.13 It should be noted that a large radiodiagnostic department is likely to be more efficient than several small ones because staff and equipment can be more effectively employed. Departments should as far as possible be centralised which may allow the number of diagnostic rooms to be reduced. Satellite rooms are generally not cost effective; only exceptionally should fixed equipment be provided outside the radiodiagnostic department.

2.14 The output of specific diagnostic rooms will vary considerably depending on such factors as the type of equipment installed and scope of examinations undertaken. For individual schemes it is important for the project teams to make full use of their professional advisers to obtain statistical and other relevant material. Recognition must be given to particular local needs and related trends, together with geographic and organisational factors which might be expected to change.

2.15 A method describing how the number of radiodiagnostic rooms likely to be required can be calculated is given in Appendix V together with a worked example.

Location of the department

2.16 Radiodiagnostic services must be available both in and out of normal working hours. The radiodiagnostic department should be sited immediately adjacent to the Accident and Emergency department which would normally be located at ground floor level. The department should be easily accessible from the out-patient accommodation (including the fracture clinic) and the in-patient accommodation and main entrance (Figure 1). Only in exceptional circumstances should satellite radiodiagnostic rooms be provided in the Accident and Emergency department.

The following aspects of siting merit particular attention:

a. The relationship between the radiodiagnostic department and the Accident and Emergency department is important since emergency medical care for severely injured patients may continue in the radiodiagnostic rooms. Thus the clinical areas of the two departments should be contiguous.

b. The relationship between the radiodiagnostic department and the fracture clinic is significant as relatively large numbers of patients, many of whom will have difficulty in walking, are referred from one to the other.

c. The proximity of the ante natal clinic to the radiodiagnostic department will depend upon where obstetric ultrasound facilities are provided.

d. It is also of particular importance that the relative locations of the radiodiagnostic department and wards be considered with regard to movement of in-patients outside normal working hours.

Internal departmental relationships

2.17 The radiodiagnostic department should be designed so that it is possible to undertake diagnostic examinations outside normal working hours without activating the whole department. Access to these facilities will be required by both the Accident and Emergency department and the wards at all times. Processing and clerical facilities together with sub-waiting space will also need to be available.

2.18 It is similarly important that the various activities within the department are correctly associated to ensure that it functions in as rapid and efficient a manner as possible. The necessary relationship between the diagnostic rooms and the processing/viewing areas and the connection between the sorting, reporting and despatch areas are examples of this need. (Figure 2)

Departmental alarms and communications

2.19 The four types of communications systems which will normally operate within the radiodiagnostic department are:

a. Telephones: Extensions from the PBX for communication with other departments and outside the hospital will be provided in accordance with the whole hospital telephone policy.

b. Patient/staff call system: This system enables patients to call for assistance and staff to summon help in an emergency. The system should be installed throughout the department with call points in each patient area, eg WCs, changing cubicles and recovery area. The main termination panel should be located at the nurse base and repeated at reception and be clearly visible from the senior radiographer's desk sited in this area. A switch-through facility to the Accident and Emergency department should be installed to cover emergencies outside normal working hours. (5.66)

c. Departmental intercommunication system: This system enables staff to call one another within the department. It may also be desirable to link the intercom system with the Accident and Emergency department for use outside normal working hours. (5.65)

d. Hospital staff location system: The staff location system employed throughout the hospital should give adequate cover for the radiodiagnostic department. (5.67)

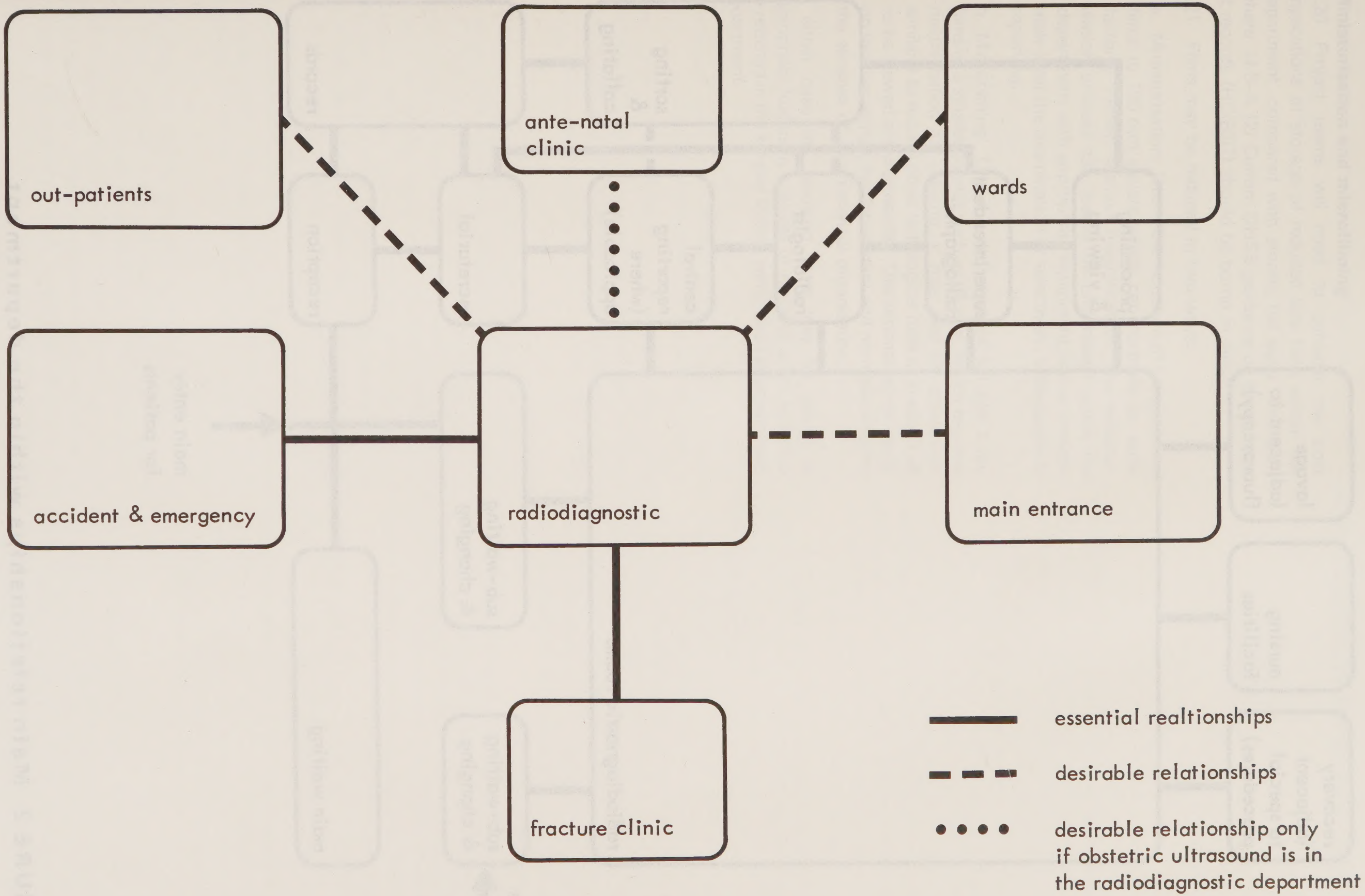


FIGURE 1 Locational relationships with other departments

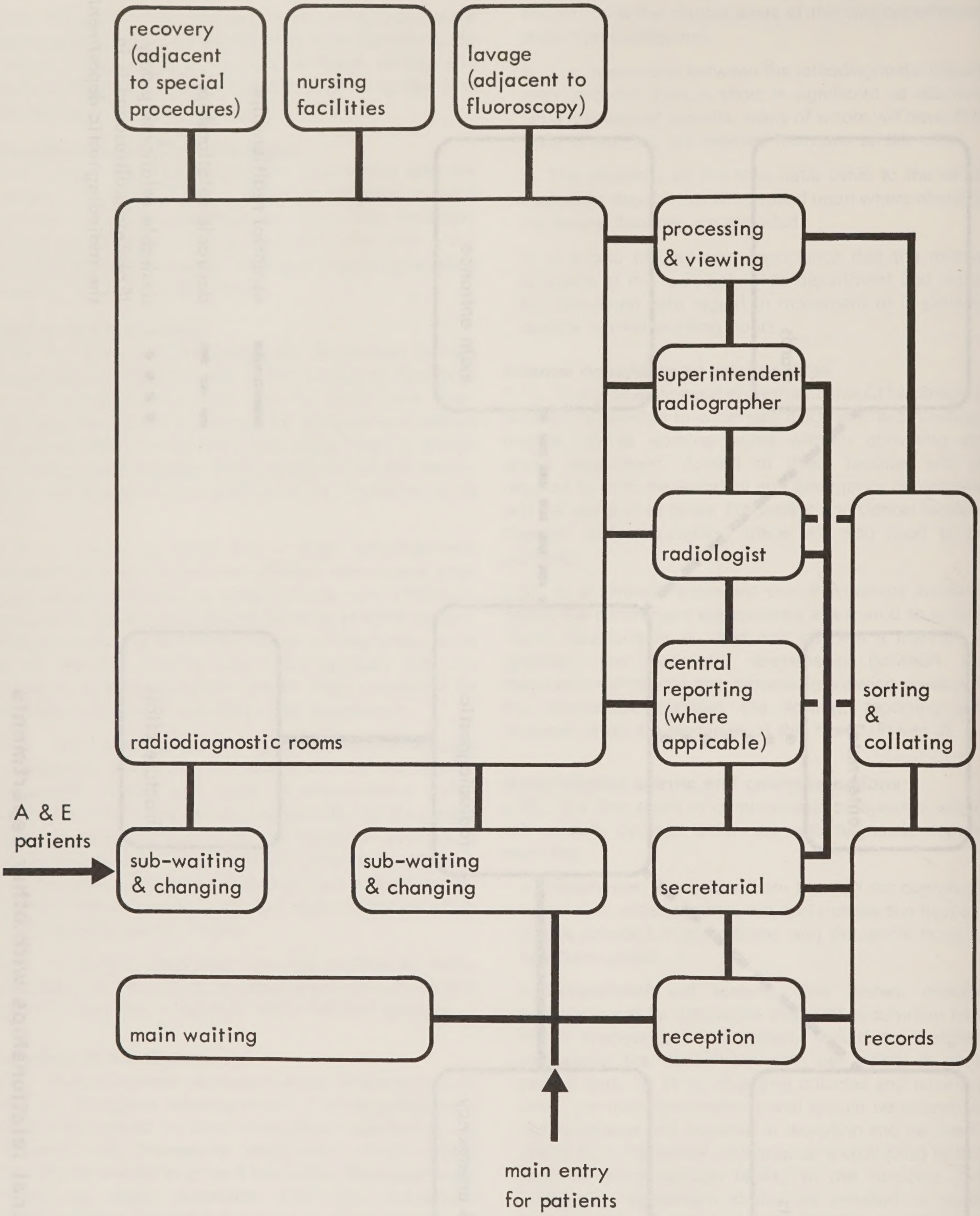


FIGURE 2 Main relationships within the department

(the flow lines indicate the main relationships but do not signify their degree of importance)

Miniaturisation and microfilming

2.20 Project teams will need to consider the cost implications of storage of reduced size films within the department, compared with storing full sized films elsewhere. (4.9–4.12) Current DHSS guidance on the storage of records (HC(80)7) should be borne in mind.

2.21 Films may be reduced in two ways:

a. Miniaturisation: This is the reduction of full size X-ray films to 100 mm square which can normally be satisfactorily viewed without magnification. The miniaturisation process can readily be undertaken within the department with appropriate equipment, either immediately after the examination or selectively, subsequent to reporting.

b. Microfilming: This is a reduction of full size X-ray films to a smaller format such as 35 mm, which requires magnification for viewing. It may also be convenient similarly to reduce other radiological data to enable it all to be viewed simultaneously. This process is not easily undertaken within the department and normally requires the services of a commercial organisation.

In either case the resulting films may be stored in appropriate folders in cabinets or retrieval units, and thus be retained in the smaller format within the radiodiagnostic department.

3 General design considerations

Statutory and other requirements

3.1 It is Government policy that health buildings should comply with the technical requirements of all relevant statutes and regulations even though the Crown need not always follow the procedural requirements of such legislation. Health buildings should also comply with all relevant codes of practice and standards. While this guidance is compatible with the statutory and other requirements in force at the time of writing, it does not relieve health authorities of the responsibility of ensuring compliance with statutes, regulations, codes and standards at all stages in their building projects.

Upgrading or adaptation of existing buildings

3.2 The standards set out in this guidance apply to the provision of departments by new building. It is not intended that they should be applied retrospectively to existing stock. However, the principles are equally valid and should be applied, so far as is reasonably practicable, when existing departments are being upgraded or a new department is being constructed within an existing building previously used for other purposes. In such cases the aim should be to meet building note standards wherever possible although it is recognised that compromises that do not prejudice safety standards will inevitably have to be made.

3.3 The cost of upgrading work should conform to the guidelines indicated in the Department's WKO letter (81)4 issued on 24 July 1981. These guidelines take into consideration the estimated life of the existing building and the difference in cost between an upgraded building and a new building.

3.4 When comparing the cost of upgrading or adapting an existing building to that of a new building, in addition to the building cost, due allowance must be made for the cost of relocating patients and staff, demolition and salvage costs, disruption of services to other parts in a phased project, and the temporary effects on running costs of any impaired functioning of areas affected by upgrading.

Fire safety

3.5 At the time of writing, Departmental guidance on all aspects of fire safety is being prepared in a number of documents within the Health Technical Memoranda series. It is essential that project teams familiarise themselves with this guidance and the statutory regulations on the subject. In particular, the need for structural fire precautions and means of escape from the whole accommodation must be taken into account at the earliest possible planning stage. Guidance on fire safety as it applies to new health buildings and new parts of health buildings (eg extensions) is contained in HTM 81 'Fire Safety in Health Care Premises—Planning and Design of New Buildings' (a draft of this document has already been circulated within the NHS under the title 'Fire Safety in Health Buildings' dated September 1978). The importance of fire precautions in health care buildings is dealt with in HTM 83, Chapter 6 of which contains specific guidance relating to radiodiagnostic departments.

3.6 During the design stage it is important to establish those aspects of fire safety strategy which affect the design, configuration and structure of a project. The architect and engineer should discuss and verify their proposals with the local fire authority from the inception of the scheme through to completion, and ensure that the project team and all other planning staff are fully acquainted with the *fire safety strategy* for the design in terms of operation (staff responsibilities etc), equipment provision, and building and engineering layouts.

3.7 The principles of fire safety apply to new projects and to alterations and upgradings of existing buildings. When altering or upgrading the aim should be to eliminate any existing fire risks.

Economy

3.8 Economy is important particularly in space provision, maintenance, staff utilization and energy consumption. The total capital expenditure must be borne in mind, but it is equally important to ensure that running costs are kept to a minimum and the cost consequences of project decisions are fully considered. A booklet entitled 'Note on the relationship between planning health buildings and the cost of running them', was issued in September 1980 with HN(80)29, and should be of interest to design teams. It contains a list of 17 works of reference relevant to the subject, and synopses of some of them. Reference should be made to HN(81)30 dated October 1981, which sets out arrangements for the approval and control of building developments.

3.9 Planning should ensure that spaces are used as intensively as possible and are not duplicated. Correct working relationships will help to facilitate economy. For example, an open-planned area comprising current film storage/sorting and collating/despatch and return, may well assist in creating an easy workflow as well as economy in space.

3.10 Materials and finishes should be selected to minimise maintenance and cleaning costs, but while being compatible, should also be functional and of a high standard, durable and easy to clean. In particular, floor finishes should be restricted in variety, and soft floor

This diagram illustrates activities and is not intended to represent spaces

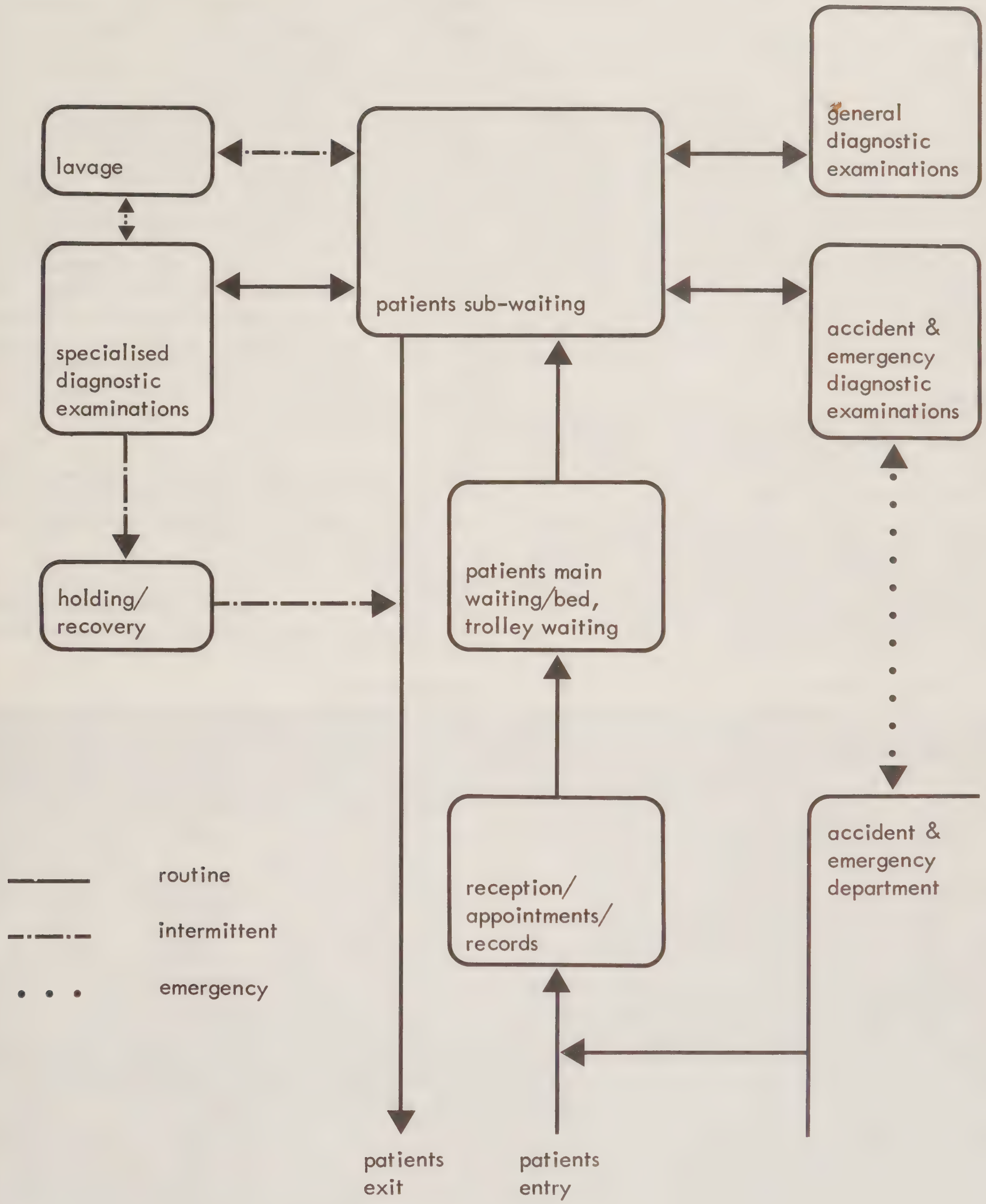


FIGURE 3 Patient flow - sequence of activities

(assuming direct access from accident & emergency)

coverings should have backing impervious to fluids; pale coloured floors are recommended because exposed films when dropped cannot easily be seen on a dark floor. Building elements which require frequent redecoration or are difficult to service should be avoided. Components which are liable to damage such as entrance doors, corners on partitions and counters should be adequately protected.

Damage in health buildings

3.11 When designing and equipping health buildings the likely occurrence and effects of accidental damage should be considered. Damage in health buildings has increased over the years through the use of heavier mechanical equipment for the movement of patients and supplies and is also due to some extent, to the use of lightweight, often less robust, building materials. Reference should be made to the relevant British Standards and to the advice in the Department's DS (Supply) letter DS 42/75 dated 5 August 1975 about the buffering of movable equipment. Reference should also be made to the guidance contained in Volume 2 of Health Building Note No 40, 'Common Activity Spaces.'

Security

3.12 There should be access to the radiodiagnostic department at all times. It will be a matter for local decision whether or not parts of the department are locked at night for security reasons, eg current film store.

3.13 Wherever supplies, such as linen, drugs, films, chemicals, instruments or cleaning materials are stored, precautions against theft will be required, eg cupboards may need lockable doors. Security arrangements for the radiodiagnostic department should be compatible with those for the rest of the hospital.

3.14 Assault on hospital staff and theft of NHS property are, nowadays, recognised problems. The project team should discuss hospital security with the officer in charge of the local Police Crime Prevention Department, and the hospital or district security officer or adviser. Fire and Safety Officers should be consulted concurrently at an early stage in the design of the building for the demands of security and fire safety may sometimes conflict.

Smoking

3.15 Health Circular HC(77)3 dated March 1977 reviews the problems presented by smoking in health buildings, and while recognising that the responsibility for making rules rests with the individual health authority, recommends that smoking should be confined to specially designated areas. In such areas ventilation should be sufficient to prevent discomfort to non-smokers and the spread of odours to other areas of the premises.

Critical dimensions

3.16 The figures in Appendix VIII contain information on critical dimensions for some of the activities mentioned in this Note and which do not appear in Health Building Note No. 40, 'Common Activity Spaces'.

Health equipment note

3.17 Guidance on equipment for a radiodiagnostic department is contained in Health Equipment Note 6, 'Radiodiagnostic Department' published 1982. This Note being the more recent publication should be regarded as the authoritative document should there be any discernible differences in the description of a Radiodiagnostic Department.

Computer applications in radiology data storage

3.18 Computer systems are likely to have advanced sufficiently as to be in general use when departments designed to the guidance given in this Note are commissioned. At least part of the patient data storage is likely therefore to use a system with computer terminals located in such areas as reception, current film store, sorting and collating, the clerical accommodation and possibly in the reporting areas. The overall area required for these activities may be affected by the kind of system adopted and in particular the degree to which computerisation is used. Systems may provide operational convenience plus considerable savings in both capital and revenue costs. Project teams should consider the installation of a computer system in any new project, possibly co-ordinated with a similar system in the patients' services department. It should be borne in mind that the power requirements and cable distribution arrangements for such systems will affect the engineering requirements of the radiodiagnostic department.

Training

3.19 Appropriate colleges should be consulted at the initial planning stages on those departments where it is envisaged that radiologists and student radiographers will be undergoing training.

Signposting

3.20 Signposting should form part of the whole hospital policy and be in accordance with the Department's signposting manual, HTM 65 'Health Signs'.

Disabled persons

3.21 It is essential to ensure that suitable access and facilities are provided for disabled people. Authorities are reminded of the need to comply with the provisions of the Chronically Sick and Disabled Persons Act 1970 and the Disabled Persons Act 1981. Attention is also drawn to BS 5810: 1979 'Access for the Disabled to Buildings': one of the effects of the 1981 Act is to apply this British Standard to premises covered by the 1970 Act, which includes those open to the public.

4 Functional requirements

4.1 This chapter enlarges upon the objectives, functional requirements and design implications of each of the main elements in the accommodation described. Activities, equipment, environmental conditions, and finishes of walls, floors and ceilings are detailed in the Activity Data sheets listed in Chapter 7.

Patient flow

4.2 A common sequence of patient movement (Figure 3) through a radiodiagnostic department is:

a. arrival at reception (escorts would report some arrivals) for documentation procedures

b. direction of patient to the main waiting area or to a diagnostic room sub-waiting area by clerical or auxiliary staff

c. preparation of patient for examination if necessary, eg undressing in a changing cubicle

d. diagnostic examination

e. waiting in the diagnostic room or returning to the sub-waiting area or a cubicle to wait until the films have been processed and checked

f. patient leaves the department (after dressing, if necessary).

Reception/appointments area

4.3 The reception/appointments area is the focal point of the department, and should be designed to serve the whole department. Patients should report their arrival here, as it is desirable for all documentation to be centrally prepared and maintained. There should be a counter for documentation and appointment procedures and a separate section with auditory privacy to allow for confidential discussions, eg on the implementation of the 'ten day rule' for female patients. (Appendix II). A workstation for a senior radiographer should also be provided in this area.

4.4 The main patient waiting space and associated bed/trolley/wheelchair waiting space should be capable of being supervised by the reception staff.

Patients' main waiting area

4.5 The main waiting space for patients and their companions should be easily accessible from the entrance to the department and be overseen from the reception area. It should have a comfortable and relaxing environment with domestic-type finishes and furnishings. Natural light and ventilation are desirable.

A single reception area to serve the whole department

A patients' main waiting space, with natural lighting and ventilation

Bed/trolley/wheelchair waiting area

4.6 An area, separate from the other waiting areas, should be provided for patients on beds or trolleys to wait in before diagnostic procedures. It may also be desirable for patients in wheelchairs to wait here rather than the main waiting area. The space allowed should reflect which option is chosen. In this area circulation space will be required for nurses or others attending the patient and for additional equipment which may be on trolleys. The waiting area may be a recess off the relevant circulation space and should be observable from the reception point. Curtaining should be provided for privacy when required.

Porters' base

4.7 A space, also capable of being seen from reception, should be provided near the entrance to the department, for porters. A departmental intercom station may be needed. (2.19c)

Master index/report index/diagnostic index

4.8 Data storage should be adjacent to or form part of the reception/appointments area. Whilst it is common practice at the present time for patient data to be held on cards in filing cabinets or in electronically operated retrieval units, it is probable that computerised systems currently being developed will supersede these methods. (3.18)

Current film storage

4.9 This Note assumes that X-ray films of patients examined during the last two years, including any previous films of these patients, will be stored in the radiodiagnostic department in correctly sized envelopes which may also contain reports.

4.10 These records are required for out-patient clinics, patient admissions, and other medical uses within and without the hospital. Storage space for current films should be adjacent to reception and patient data storage, and be directly accessible from the despatch and return area.

4.11 Fixed racking should be provided for functional reasons and the structural design should take account of the weight of X-ray films stored in bulk. Circulation space for film trolleys will be required and space will also be needed for tables and worktops. Storage for other recording media (video or magnetic tapes and reduced size films) should also be provided here if required.

Archival film storage

4.12 All other films should have different arrangements made for their storage. If it is decided to retain archival films in their full size format, they should be stored conveniently near the department or with central medical

A current film store with fixed racking, film trolley and worktop

A patients' sub-waiting space conveniently situated to the diagnostic rooms. (See HTM 65 'Health Signs' for current radiation hazard/warning signs)

records. The filing system should be compatible with the main medical records. Mobile racking, whilst not suitable for current filing, may be considered for archival storage where continuous ready access is not required, thus utilising its space saving potential. Reference should be made to local and national statistics to confirm the area required for this storage in the light of the consistent increase in diagnostic radiology demands. The Departmental Cost Allowance for such archival storage is included in that for medical records.

4.13 For both the current and archival film stores, security of the potentially valuable X-ray film must be borne in mind to ensure there is no unauthorised removal for silver recovery purposes.

Patients' sub-waiting areas

4.14 Sub-waiting spaces should be provided convenient to the diagnostic rooms for patients awaiting examinations or subsequent film checks. Each space should normally serve at least two diagnostic rooms. The space associated with Accident and Emergency patients should however be somewhat larger to allow for a greater proportion of wheelchair cases; it should also be borne in mind that this space will need to be available for use outside normal working hours. Where possible, sub-waiting spaces should have natural light and ventilation and be designed to ensure that there is privacy for patients (who may be in dressing gowns).

Note: Although information covering radioisotope imaging/nuclear medicine has been excluded from this Note, it may be necessary to consider the proximity of such facilities. For example, patients who have been injected with radioactive isotopes should be segregated from pregnant women.

Changing cubicles

4.15 Cubicles should be planned in groups and be associated with the sub-waiting areas. They would normally be of a single door type and should provide facilities for patients to dress and undress in privacy and for the secure storage of clothing during their examination. Separate administrative arrangements should be made for the safety of valuables. Cubicles should have some means of identification, eg be numbered or colour coded both inside and out. Three changing cubicles will generally be required to serve each diagnostic room. One of the cubicles in each group should be suitable for use by assisted, ambulant patients accompanied by an escort. It is assumed that wheelchair patients will be taken directly into the radiodiagnostic room.

4.16 Alternatively cubicles may be of a pass-through type with a door at either end, one of which opens directly into a diagnostic room and must therefore be radiation-protected. These doors are costly to provide and restrict the use of wall space in the diagnostic room.

4.17 An advantage of such cubicles is that they enable patients to wait in them and not in the sub-waiting area in a semi-undressed state, but some patients find these cubicles claustrophobic.

Diagnostic rooms

4.18 Detailed user requirements can be found in the Activity Data Sheets and critical dimensions are given in Appendix VIII.

A general purpose diagnostic room with natural lighting and a good relationship between the main door and the X-ray table. It should also be noted how the pass-through changing cubicles restrict the use of valuable wall space in a room of insufficient width

4.19 In broad terms, diagnostic rooms fall into two categories; general purpose rooms and specialised rooms. Decisions on individual room functions and layouts should be taken by the project team in consultation with a radiologist and superintendent radiographer from the department concerned and a radiological engineer. Wherever possible, all these rooms should have natural lighting but will require mechanical ventilation; some specialised rooms may also need the ventilation air to be cooled.

Location

4.20 In selecting diagnostic room locations, care should be taken to relate the specific room activity to its position within the department. To minimise patient and staff traffic, the diagnostic rooms with a high patient-throughput should be situated near to reception, and those for more protracted procedures furthest away.

General purpose diagnostic rooms

4.21 These rooms need dim-out facilities and contain heat emitting equipment. They should therefore be mechanically ventilated to provide a suitable environment for patients and staff. For recommended conditions see the appropriate Activity Data Sheets.

4.22 Workflow sequence is as follows:

a. the radiographer reads the X-ray request and reviews previous reports and films (if any) on a viewer

b. the patient is brought into the radiodiagnostic room from a cubicle or waiting area

c. the patient is positioned and the examination carried out

d. the X-ray films are then marked with the patient' details

e. patient waits in radiodiagnostic room or returns t sub-waiting areas whilst the films are being processe

f. the radiographer goes with documents and previou films to collect the newly processed films and check them in an associated viewing area

g. if the films are unsatisfactory, the examination i repeated; if satisfactory, they are sent for reporting.

Specialised diagnostic rooms

4.23 Workflow in these rooms will follow a similar basi sequence but will vary according to the type of examina tion being undertaken; eg fluoroscopy, special pro cedures, ultrasound or urography, and on whether or no a radiologist is directly involved. In addition, the examin ation times may be longer due to the greater complexity o the procedures used. Some of these examinations are des cribed in Appendices II and III.

4.24 Some kinds of interventional radiology require staf to wear heavy protective garments for extended periods o time. Under certain circumstances a degree of asepsis i necessary. These, and other procedures such as ultra sound, are usually carried out in low-level illumination Rooms used for these procedures may require to b cooled. In addition, depending on the specific function they may require other engineering facilities. (5.40)

4.25 It may be desirable on occasions to sub-divid rooms to enable two patients to be examined concurrentl (urography—Appendix III paragraph 7).

Ceilings and ceiling-mounted equipment

4.26 The majority of diagnostic rooms contain ceiling mounted equipment, such as X-ray tubes or image inten sifiers or both. To provide both for the overhead service for this equipment without detriment to clinical require ments, and a built-in flexibility for maximum choice o equipment and location, both at the outset and during th life-span of the building, it is recommended that a structural modular steel grid should be hung from the floo above. This grid will have the dual function of supportin the ceiling-mounted equipment and a suspended ceilin which will incorporate recessed lighting fittings and con ceal the primary electrical supply cables. The supportin steel grid should be sc designed as to enable the tracks t be mounted wherever required at the level of the sus pended ceiling. This should comprise demountabl modular tiles with interchangeable recessed modular light ing fittings which are capable of being placed in an desired position so that they are not obstructed by th equipment.

4.27 The ceiling-mounted equipment which is currentl available can impose a moving load of up to 1500 kg and a possible horizontal force of 1600 kg. The maximum deflection of the supporting tracks when loaded must not exceed 1.5 mm, irrespective of the location of the carriage. Project teams are advised to consult thei regional radiodiagnostic equipment engineer and manu facturers about the weight factors of all equipment as these can vary considerably.

4.28 In diagnostic rooms there must be a clear minimum height (over the whole room) between the finished floor level and the support for the direct suspension of radiodiagnostic equipment of 3.1 m. To enable certain types of equipment to be installed, this dimension may have to be greater. The regional radiological engineer should be consulted about the likely dimensions required. (All manufacturers will be able to provide information from their planning departments.)

4.29 It will be necessary to consider the position of lighting fittings when positioning equipment. There are three key requirements:

a. patients under investigation who will be lying on X-ray tables should not have to look directly up into bright lights

b. the movement of ceiling-mounted equipment should not unduly obstruct the light produced

c. variable levels of illumination should be provided to enable different tasks to be performed:
   i. low-level to enable a radiographer to see clearly a light beam diaphragm, used when aligning the X-ray beam, and
   ii. brightly lit for certain investigations and for the installation and maintenance of equipment.

4.30 The construction of modular suspended ceilings enables modular ceiling panels and recessed lighting fittings to be interchangeable. When a suspended ceiling cannot be provided it will be preferable to install lighting fittings at or near the junctions of walls and ceilings. If lighting fittings are at a lower level on walls, or near to eye level, they can cause an uncomfortable glare.

Walls

4.31 There are two types of walls in diagnostic rooms, one of solid construction and the other hollow-core partitioning. The latter provides flexibility in the use of rooms and enables services to be installed within them. Both types of walls must have radiation protection to the standards required. (Project teams should consult the radiation protection adviser.) All walls should have a load-bearing capacity for equipment. This requirement may involve a side thrust of up to 200 kg and point loads of up to 100 kg. Walls should be flush and without structural protrusions.

Floors

4.32 It is essential that great care is taken in the design of the floor. Equipment will normally be replaced a number of times during the life span of a radiodiagnostic department and initial planning should ensure that this can be done with the minimum disruption to the room concerned. The floor in each room should be capable of supporting a total load of up to 5000 kg, although no single item of equipment is likely to weigh more than 2500 kg. The radiological engineer should be consulted on the likely weights of such equipment. The floor should permit easy installation of trunking, 100 mm in depth, with a minimum cross sectional area of 150 cm^2 required for cables to diagnostic equipment and other apparatus. Alternative methods which may be employed to increase flexibility when exchanging equipment and installing new cable runs are described in detail in Appendix IV.

4.33 To ensure ease of access for wheelchairs, trolleys, and beds, the floor surface should be at the same level as the surrounding corridors. For hygiene and ease of maintenance the floor finish should be impervious to fluids.

Equipment

4.34 Provision should be made in all diagnostic rooms for basic equipment (3.17); such equipment includes one or more of the following individual items:

a. high voltage transformer (generator), maximum weight 750 kg

b. control console, maximum weight 370 kg

c. specialised equipment racks, maximum weight 310 kg

d. X-ray tube support:
   i. floor to ceiling (usually known as 'tube column'), maximum weight 300 kg
   ii. ceiling-mounted X-ray tube support, maximum weight 380 kg

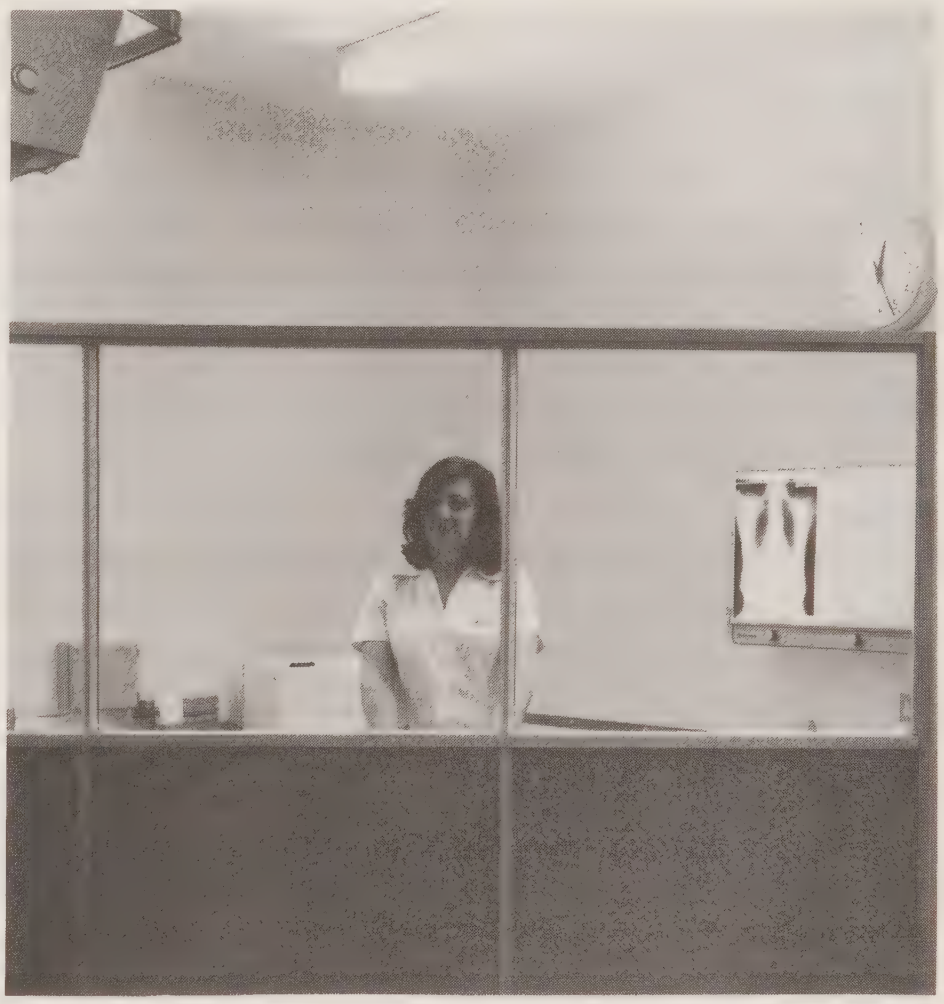
e. X-ray tube, maximum weight 100 kg

f. other examination equipment:
   i. X-ray table and/or examination equipment, maximum weight 2500 kg
   ii. chest stand (or equivalent), maximum weight 205 kg

g. racks for protective clothing, aprons and gloves, maximum weight 50 kg

h. ceiling-suspended image intensifier, maximum weight 460 kg.

See Appendix VI for details of above equipment.



A radiation-proof screen to a control cubicle providing the radiographer with an uninterrupted view of the patient

Control cubicle

4.35 The control console should be placed behind a radiation-proof screen in order to protect the operator. This area is known as a control cubicle. The cubicle must provide radiation protection for the operator at the control

console and for other staff who are present during a radiological examination. It may also provide protection for access into an adjoining X-ray film processing area. If the screen is located in front of the access to the processing facilities and fully protects the opening, a radiation-protected door need not be provided. The screen should be of solid construction to a maximum height of 1.1 m with an upper section of radiation-proof transparent material which allows an unimpeded view of the patient at all times. The total height of the screen should be not less than 2 m from the finished floor level. The degree of radiation protection required can vary with circumstances. It is therefore essential to seek the advice of the Radiological Protection Adviser on this aspect.

Anaesthetics

4.36 Piped oxygen and vacuum should be provided in each diagnostic room and recovery area. (5.39) In addition, nitrous oxide will be required in each special procedures room. Where nitrous oxide is used a gas scavenging system will be required. (5.40) As it is not possible to ensure that diagnostic equipment and associated apparatus is spark proof, only non-flammable anaesthetics and materials should be used. Antistatic floors will not be required. (See Chapter 5 of HTM 2).

Nursing facilities

4.37 Nursing facilities, comprising the nurse base, clean utility area, patient holding and recovery area, and dirty utility room should be provided and planned as a cluster of activity spaces in the vicinity of the specialised rooms.

Nurse base

4.38 A base is needed for the nursing staff. It should be planned as a focal point in the cluster of nursing facilities, and give direct observation of the patients in the holding and recovery area. Space is required for a desk and telephone for administration. Indicator lights for the patient/staff emergency call system and the Controlled Drugs cupboard should be located so they can be seen from the desk and circulation spaces.

Clean utility

4.39 A clean utility area should be provided for the storage and assembly of clinical requisites used in the radiodiagnostic rooms. These include sterile supply items, pharmacy supplies including drugs, Controlled Drugs, contrast media, and other non-sterile clinical supplies. Certain pharmaceuticals used during barium examinations may also be stored and prepared in this area. Trolleys will be 'laid up' here for all specialised examination sessions.

Holding and recovery

4.40 A holding and recovery area will be required for patients in bed or on a trolley who require infusions or other similar procedures prior to investigation and for those who are recovering from anaesthetics. Emergency resuscitation equipment should be based here. The amount of space required for parking beds or trolleys will depend upon the number and type of procedures carried out in the specialised rooms. Each bed or trolley space should be able to be curtained off for privacy.

4.41 The activities described in 4.38, 4.39 and 4.40, namely the nurse base, clean utility area and patient holding and recovery area, can conveniently be combined into one space.

Dirty utility room

4.42 A dirty utility room should be provided for the cleaning of trolleys and equipment used in clinical procedures which is not sent to the Sterilizing and Disinfecting Unit (SDU). There should be a space for the temporary holding of materials for disposal and reprocessing, eg soiled linen for the laundry and items for return to the SDU. Special consideration should be given to the provision of a slop hopper with adequate drainage to avoid clogging by barium. A bed pan washer unit or macerator will also be required.

Lavage rooms

4.43 A lavage room containing WC and bidet, suitable for both ambulant and trolley patients, should be provided for those patients who require a colonic lavage. An additional, smaller room for ambulant patients only may be required for larger departments. All lavage rooms should be convenient to the fluoroscopy rooms they serve.

Patients' WCs

4.44 The number of patients' WCs required will depend on the size of the department. They should be located convenient to the main and sub-waiting areas. At least one such WC should be of the wheelchair type.

4.45 Sufficient assisted WCs with bidets should be provided for patients' use on completion of barium enema examinations. These WCs should be immediately adjacent to, but should not have direct access from, the fluoroscopy rooms. For patient privacy, access to these WCs should be screened from the main circulation space and sub-waiting area.

A barium enema WC should not as shown here have direct access from a fluoroscopy room as this impedes the use of both rooms

4.46 There should also be a WC adjacent to any room used for urographic examinations, (Appendix III paragraph 7) or where the state of the bladder is an integral part of the examination, as in many ultrasound investigations.

Film processing

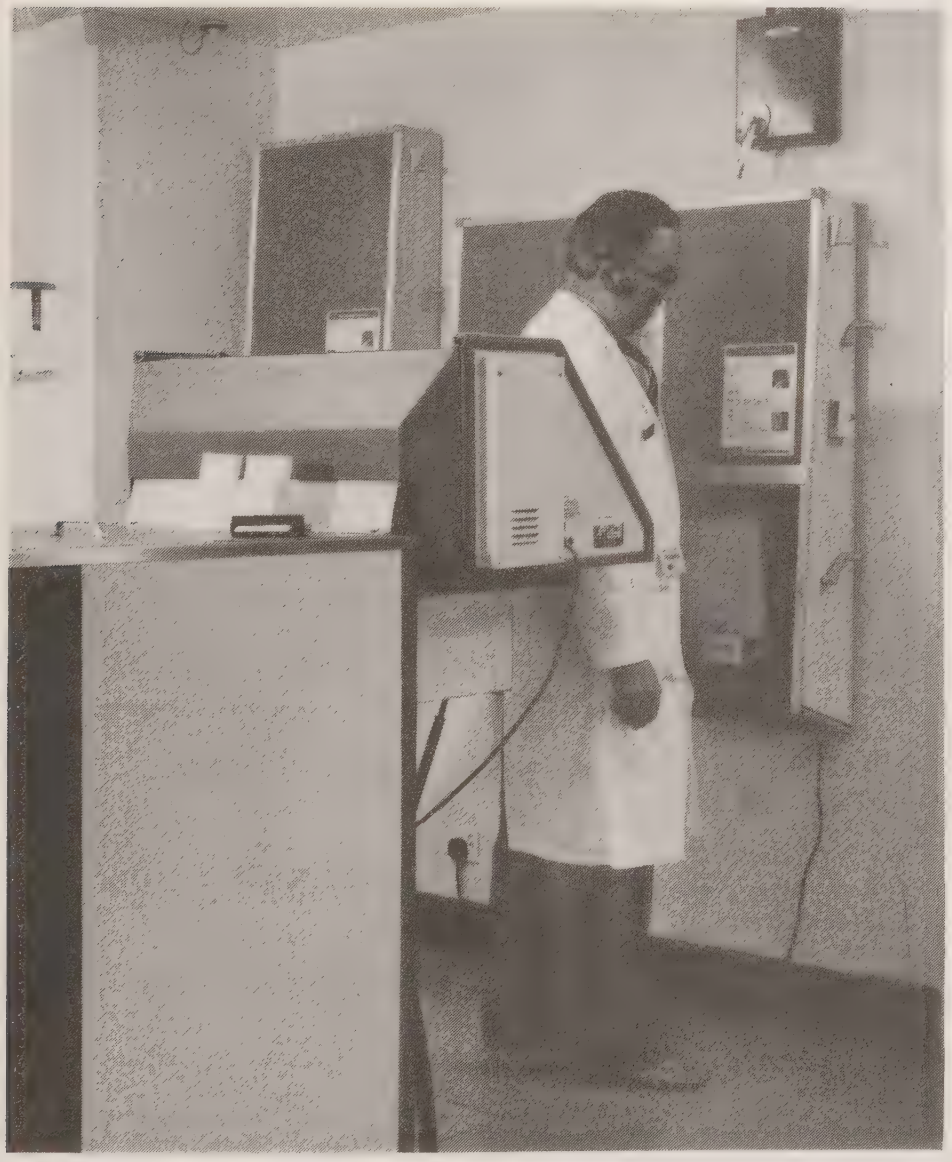
4.47 Developments in processing technology have made it possible to process most X-ray films without the use of dark rooms. This Note has therefore allowed for daylight automatic processing, and daylight automatic processing with a dark room facility.

Manual processing

4.48 If exceptional local circumstances require the provision of manual processing, a case should be made for the additional space required.

Daylight systems

4.49 Daylight automatic processing and film handling can be undertaken in areas of natural daylight or artificial light by the use of light-proof film feeding devices. A number of commercial daylight systems are available with differing arrangements for loading and unloading film cassettes. These can be broadly classified into integrated and dispersed systems. In the former, the unloading and reloading of the cassettes, as well as the processing of film, are all undertaken in the one unit. With dispersed systems, the reloading of the cassettes is separated from the other processing functions, thus enabling this activity to be undertaken independently.



Modern film-handling systems permit cassette loading, unloading and film processing to be undertaken in natural or artificial light

4.50 The choice of a particular system will have a bearing on the layout of the processing areas and their juxtaposition to the radiodiagnostic rooms. The total area provided should be related to and adequate for the number of radiodiagnostic rooms in the department. The areas containing automatic loaders or dispensers can with benefit be capable of having light excluded to enable some equipment malfunctions to be rectified without spoiling unused films. In such situations safe-lighting should be provided. In all cases a sink for cleaning the processor racks must be sited conveniently.

4.51 Each department should be equipped with automatic processors at a ratio of one to every two radiodiagnostic rooms. If an automatic processor is to serve one item of radiodiagnostic equipment only, it should not be included in this calculation. All departments should have at least two automatic processors, one for normal use and a smaller one of lower capacity as a standby in case of breakdown. In departments with two processors or more, a separate standby processor will not be required. However, allowance may have to be made for specialised processing requirements such as dental films. The design of mechanical and electrical services should allow for each piece of equipment to be serviced independently. Their siting must be considered in the context of local requirments and workload demands, and be so arranged as to reduce staff movement to a minimum.

4.52 For example, an area with one processor can be located between a pair of radiodiagnostic rooms, or two processors may conveniently be installed in a common processing/viewing area serving a cluster of four radiodiagnostic rooms. In certain situations it may even be desirable to site a processor within a radiodiagnostic room. The overall policy should be such that alternative processing facilities are always available within a reasonable distance thus ensuring that a processor breakdown does not totally affect one type of examination.

4.53 Although the use of daylight processing is recommended, departments will still require a dark room for some facilities, eg loading of film magazines and cine-cassettes and possibly dental film processing. At least one processor should therefore be sited in a darkroom, but the design of the room and choice of equipment can be such that when not required as a darkroom it can function in normal light conditions as a daylight system.

4.54 The processor should be positioned so that the 'feed-in' end is in the safe-lit area (Appendix II) and the 'output' end in the adjacent viewing/checking/immediate reporting area. When the door is closed magazines and cine-cassettes may be passed into the darkroom via a cassette hatch. There will be a need for safe-lighting (coupled to an exterior warning light), a white light, bench space for unloading and loading cassettes, and cupboards for storage. An intercom station may also be required.

Film handling

4.55 The commonest way in which films are placed in position for exposure is by first loading each film into a light-tight cassette. Packs of unexposed films are taken from the unused film store to the various dispensing points which are located in the processing areas. Individual films

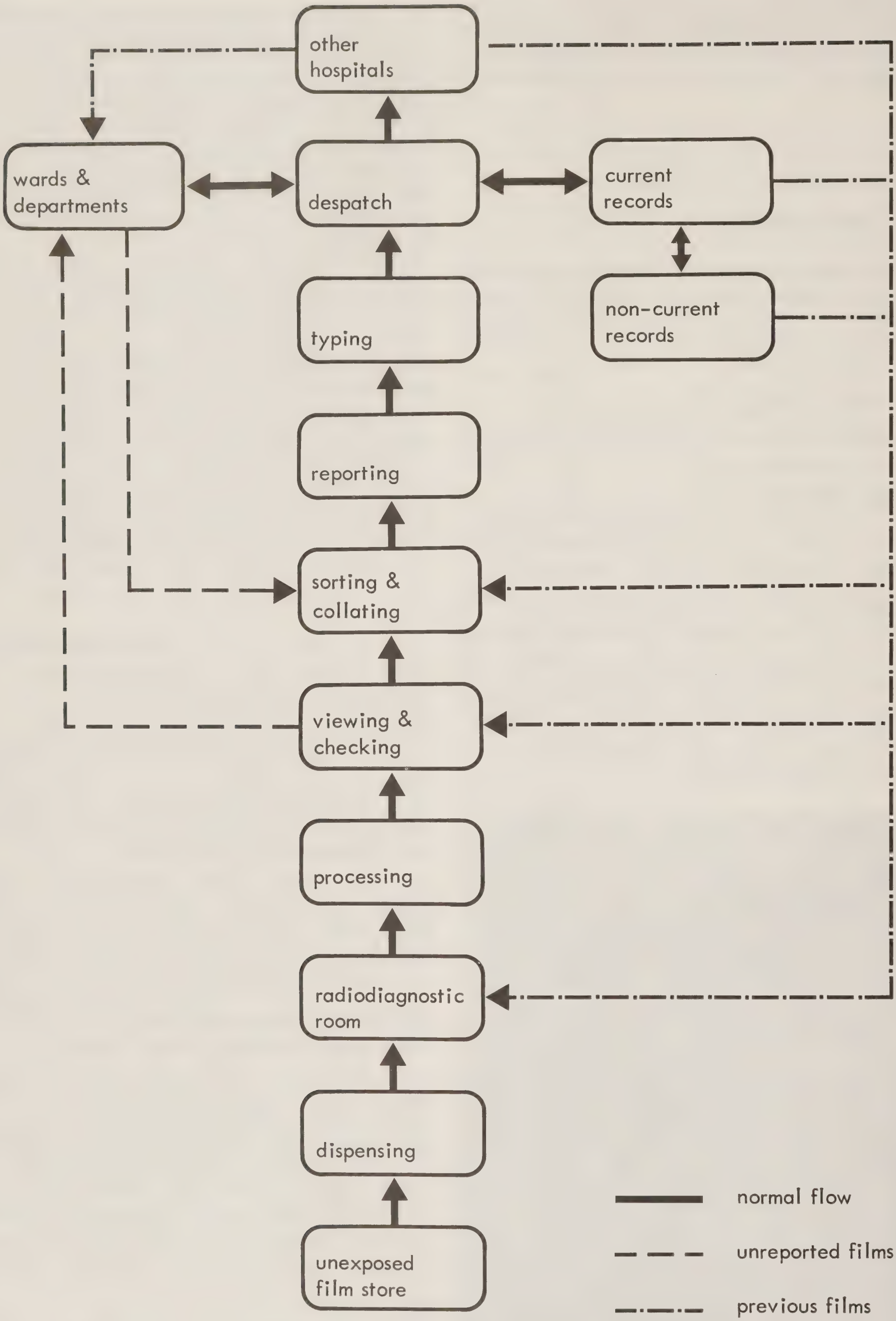


FIGURE 4 Flow of films - sequence of activities

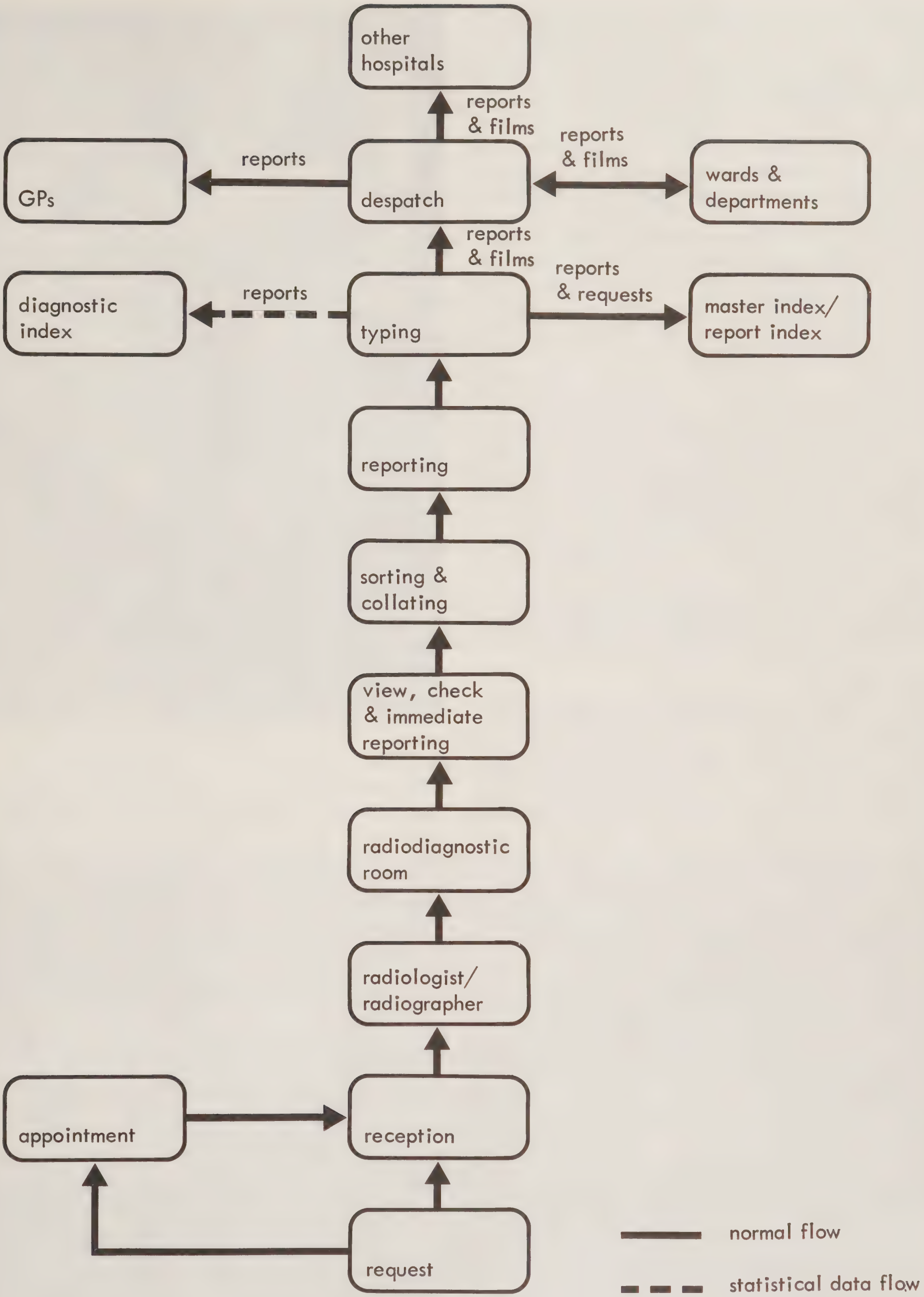


FIGURE 5 Flow of requests & reports - sequence of activities

are then placed into cassettes, ready for use in the adjacent radiodiagnostic rooms (Figure 4). After exposure, the films are fed into an automatic processor where they are chemically processed and dried ready for viewing. At all times before the completion of processing, films must be protected from exposure to light and from unwanted exposure to irradiation. Each film must be marked with particulars of the patient's identification. To minimise the chances of error, this should be done before the film leaves the care of the radiographer and preferably in the radiodiagnostic room. Films may be marked while still in the cassette; this is usually carried out by a photographic method which is provided for in the construction of the cassette. Equipment which does not use cassettes usually embodies a system of photographic marking.

Replenishment of chemicals

4.56 There are two common methods of holding the replenishment solutions used in processors:

a. Automatic mixers which will open and mix packs of chemicals automatically and give warning when further supplies are required. These avoid the need for direct contact with the chemicals and eliminate the risk of splashes into the technician's eyes during mixing.

b. Reservoir tanks into which the chemicals are poured and mixed by hand.

Both methods can serve one or more processors within the same area. If central replenishment is considered, expert advice should be sought from the manufacturer.

Silver recovery

4.57 Equipment for the recovery of silver from used processing chemicals is essential. This equipment may serve more than one processor within the same area. The various methods available for the recovery of silver are described in Appendix VI. Local security arrangements must be made to ensure the safety of the equipment from unauthorised interference and also for the safe custody of recovered silver flake.

Reporting and administration

Viewing, checking and immediate reporting area

4.58 Films should be examined immediately they are processed to determine whether the patient may leave the department or if a further film is required. Film viewers for checking (and possibly for immediate reporting) should be provided near the 'output-end' of automatic processing units.

4.59 The proper location and function of the viewing, checking and immediate reporting areas in relation to the radiodiagnostic rooms and processing areas is paramount to the speed and efficiency of the department. They should be adjacent to, or part of, each processing area and should contain worktops and viewing facilities. Space will be required to enable radiographers to check the processed films and to carry out a preliminary sorting. Immediate film reporting by a radiologist is required on occasions by the Accident and Emergency department and during out-patient sessions. This can be undertaken here or in the central reporting area. (4.68)

A viewing, checking immediate reporting area

4.60 Separate viewing, checking and immediate reporting areas should be provided for radiodiagnostic rooms which have different functions. For example, one area should be allocated to that section of the department designated to serve the Accident and Emergency department; another area, or a designated section of a large area, should be available for the viewing and checking of films resulting from examinations performed by radiologists, eg barium meals, enemas and angiography, because of the volume of films these procedures produce.

4.61 One of the following courses of action is likely to be followed after film checking (Figure 5):

a. Routine procedures: Current and previous films (if any) and documentation are taken to the sorting area for collation and reported on in batches.

b. Immediate reporting and despatch: In cases of clinical urgency films may need to be reported on immediately by a radiologist. In such circumstances it is desirable to have previous films and reports available for comparison. If this is not possible care should be taken to ensure that such 'immediate' reports are reviewed for confirmation of the findings when previous films and documents are present.

c. Despatch of unreported films: If immediate reporting is not available, and the clinician wishes to see the films before the patient leaves the hospital or before deciding on treatment, the unreported films are despatched to

the clinician (preferably in a suitably distinctive 'unreported films' envelope). Where possible, previous films will be included for comparison. The patient's original envelope and documentation will be taken to the sorting area to await the return of the unreported films.

Sorting and collating area

4.62 Project teams should pay particular attention to the design of the area used for the sorting and collating of X-ray films. If this area is not well designed it can have serious consequences for the throughput of the radiodiagnostic department, and hence the patient throughput of the hospital as a whole.

4.63 These activities should be carried out in an area adjacent to reception/data storage. To facilitate an easy flow of work, an open-planned area comprising sorting and collating, despatch and return, and current film storage, has many advantages. The accommodation should be near to the radiologists' offices and, in larger departments, to the central reporting room. Ample work-top space with viewing facilities and storage racks will be required for the various activities undertaken in this area.

4.64 The following activities take place:

a. ensuring that when current and previous X-ray films (if any) are received from the viewing/checking areas, the necessary documentation is attached before being passed on for reporting

b. collation of films and documentation in cases where previous records were not initially available

c. sorting unreported films on return from the clinician or ward and their collation with relevant previous films and documents ready for reporting

d. retrospective collation of current and previous films and documents that were the subject of an 'immediate' report to enable the initial findings to be confirmed

e. arrangements to ensure that the absence limit (usually one to three days) for unreported films is not exceeded

f. sorting films for reporting into categories, eg in-patient, out-patient, accident, and those for reporting on by a specific radiologist

g. holding films for viewing by visiting clinicians.

Many of these activities may also cover the films of patients who have been referred from other hospitals.

Film reporting and clinical conference facilities

4.65 It is essential that proper facilities for radiology report preparation and clinical radiology conferences are provided. Reports on films can be prepared in a number of places, such as the viewing/checking/immediate reporting area, a radiologist's office, or in a central reporting room.

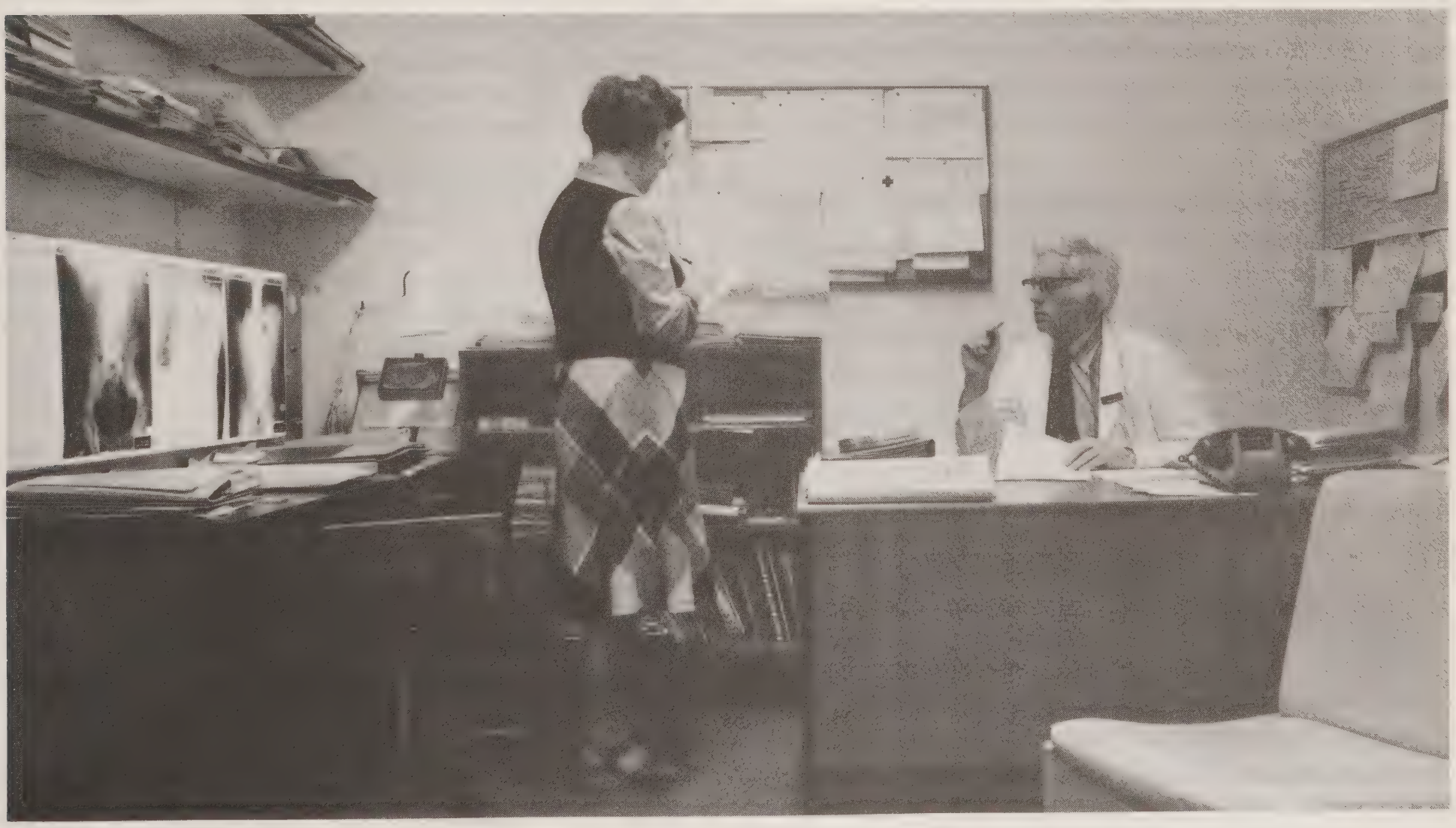
Radiologists' offices

4.66 Radiologists' offices will be required for viewing and reporting, for consultation with colleagues and others and for general administrative work. There should be an office for each full-time consultant and whole time equivalent consultant. There should also be a limited amount of storage space for books, periodicals and films.

4.67 Offices should be grouped together with easy access to the specialised diagnostic rooms, secretarial facilities and, in larger departments, to the central reporting room. Natural lighting and ventilation is desirable and the rooms should be capable of being dimmed.

Central reporting room/diagnostic conference room

4.68 A central reporting facility located near to the sorting and collating area will be required in the majority of departments from which radiological staff will be able to provide a regular flow of reports, and provide a reference point for obtaining radiological opinions. As radiological



A radiologist's office

A central reporting room with an automatic multi-viewer in use

consultations also frequently form a part of the diagnostic conferences associated with clinical ward rounds, this space should be planned large enough to allow for this additional function. Provision should be made for the radiologist, his staff and one or more clinical teams.

4.69 In small departments however, it is not envisaged that a separate central reporting space will be needed and the clinical conference function can be allowed for by providing one radiologist's office with additional space.

4.70 At the present time the results of radiological investigations are mainly presented for reporting as radiographs or as photographs taken directly from TV monitors or image intensifiers. Increasingly, however, diagnostic images are being produced in electronic form and are viewed primarily on TV monitors. The suggested three types of reporting station appropriate for a central reporting room are as follows:

a. one having a minimum of two quadruple wall-mounted illuminators

b. one equipped with an automatic multi-viewer

c. one having TV monitors, together with equipment to produce copies of TV images for distribution to clinicians. If patients' records are computerised the same monitors may be used as computer terminals by the provision of video-mixers.

The type of reporting stations will be dictated by local requirements. For large departments one of each type is likely to be needed.

4.71 Natural lighting will not be required but if windows are provided the room should be capable of being dimmed. Mechanical ventilation is, in any event, recommended. (5.25)

4.72 The radiologists, after viewing the diagnostic images, may dictate their reports directly to a typist in the central reporting room or to a dictating machine for subsequent typing. In order that these activities may take place concurrently, consideration should be given to providing sound attenuation.

4.73 A copy of the report is sent to the referring clinician (who may be in a ward, department, another hospital, or outside the hospital service altogether ie a general practitioner) for inclusion in the patient's notes and a copy is retained in the department. A further copy may be stored in the film envelope.

Clerical accommodation

4.74 Accommodation will be needed for the transcription and typing of radiologists' reports and for the preparation of the reports and associated radiographs for distribution or filing. It may be desirable for the secretary typist attached to the radiologist in administrative charge of the department to have a single room adjacent to his office. Other typists may share accommodation. Natural lighting and ventilation are desirable.

Film despatch and return

4.75 This area is used for the despatch and return of films and reports (and queries concerning their whereabouts). Ample worktop space and storage racks will be required

for the preparation of films and reports for despatch. Worktop space will also be required for the sorting of returned films in preparation for filing. The films may:

a. accompany the report to the clinician to be subsequently returned for filing in the department

b. be retained in the ward or department during the patient's course of treatment and be returned for filing when the patient is discharged

c. be sent directly for filing, eg general medical practitioner referrals.

Superintendent radiographer's office

4.76 The superintendent radiographer's office will be required for general administrative work, viewing of films, consultations and discussions with colleagues and others. Where possible the office should be located close to the centre of activities within the department. Natural lighting is desirable, and the room should be capable of being dimmed. There should be a limited amount of storage space for books and periodicals and films.

Storage

Cleaners' room

4.77 A cleaners' room to service the department should be provided.

General store

4.78 Secure storage space should be provided to house small items of equipment used intermittently, eg instrument trolleys, cassette stands, contrast injector and anaesthetic equipment. Space will also be required for bulk storage of X-ray forms, stationery, paper towels etc. Shelves should be provided for small miscellaneous items.

Unused film store

4.79 A film store will be required for the storage of stock film of all the sizes in common use. It should be sited away from radiodiagnostic rooms or shielded from radiation and should be in a location which has a cool, constant environment. The weight of the film to be stored should be taken account of in the design and positioning of shelving. Security is also important.

Chemical store

4.80 A storeroom, preferably situated near the processing areas, should be provided for storage of chemicals used in the processing of radiographs. Shelves will be required and account should be taken of the weight of the chemicals to be stored. Floor finishes should be impervious to chemical spillages.

Linen store

4.81 The provision of storage for the day-to-day working stock of linen will be required. Its size will be in accordance with the policy of the whole hospital.

Mobile X-ray equipment parking bay

4.82 Parking space for mobile X-ray units will be required including, where appropriate, facilities for charging mobile X-ray units with integral batteries. The space should be provided convenient to the appropriate entrance to the department.

Switchroom

4.83 A switchroom will be required for housing the main isolator and distribution switch/fuse-gear for the department. The room should be dry and well ventilated and the door should be lockable and open outwards. To minimise the radial length of circuit wiring the switchroom should whenever possible be located centrally within the department.

Staff accommodation

Staff room

4.84 A staff room will be required for general use by all staff of the department. Ideally, it should be sited near to the diagnostic rooms, particularly those used for Accident and Emergency. It is desirable that the room should have natural lighting and ventilation and a pleasant environment. As this room will be used 24 hours a day the provision of a couch or divan would be useful so that staff working at night can rest. Beverage making and cooking facilities are required.

Staff changing and WCs

4.85 Project teams will need to bear in mind the staff changing requirements, as central staff changing is not normally considered appropriate for radiographers. This is due in part to the need to ensure secure and safe storage within the department of the radiation monitoring devices, individually worn on radiographers' uniforms.

4.86 Female radiographers should be provided with a changing room, and appropriate accommodation should also be provided for male radiographers. All should have full length lockers for the storage of personal clothing, uniforms and personal items.

4.87 Staff working in offices should be able to lock personal items in desks, and as they will not normally use centralised staff changing, coat hanging facilities will be needed in the offices. (Information about coat hanging in offices is given in Volume I of the 'Common Activity Spaces' Building Note).

4.88 A WC with wash-hand basin should be closely related to the changing space for general use by all staff.

Shower

4.89 A shower compartment should be provided in the department for use by staff or patients.

Essential complementary accommodation

Seminar room

4.90 It is essential that accommodation for multidisciplinary radiological conferences of up to 20 persons should be provided within the hospital. For smaller departments it is anticipated that this accommodation will be shared with other users and may be sited outsde the department, possibly in a hospital education centre. In larger departments, however, it may be necessary to site this facility within the radiodiagnostic department. This will be a matter for project decision.

Workshop

4.91 A workshop for the servicing and repair of equipment, including mobile X-ray units, will need to be provided, either within the radiodiagnostic department or elsewhere in the hospital. Doors should be large enough to admit mobile units. Work involving the generation of X-rays should not take place in this room and a suitable notice to this effect should be prominently displayed.

Optional accommodation

Note: Not all departments will require the following accommodation, but a costing will be available.

Special procedures changing room

4.92 A changing room may be required adjacent to a special procedures room, depending on the nature of the work undertaken. Scrub-up facilities and space for gowning will, in any event, be needed in the special procedures room.

Anaesthetic room/bay

4.93 Project teams will need to consider the frequency of interventional radiology requiring anaesthesia which in exceptional circumstances may justify separate provision. If this is considered necessary it should be located adjacent to the special procedures room, and should include the same piped gases and vacuum, and a gas scavenging system used in special procedures rooms.

Barium preparation area

4.94 In larger departments a barium preparation area may be required.

Additional darkroom

4.95 A small darkroom suitable for limited film processing or for changing high-speed panchromatic films may be required in association with ultrasound facilities.

5 Engineering services

5.1 This chapter describes the engineering services contained within this department and their integration with the engineering systems serving a whole site. Its purpose is not to inhibit the design solution but to acquaint the engineering members of the multi-disciplinary design team with the criteria adopted (in terms of material specification, design conditions and reference material) to meet the functional requirements.

5.2 Documents referred to by number viz[10] are listed at the end of the chapter. They are numbered in order of first appearance, repeated references retaining the same number.

Model specification

5.3 The library of standard specifications issued in the CS[1] series of engineering data sheets is currently being updated and will be re-issued as a model specification for engineering services in health care buildings. The cost allowance for the engineering services in each functional unit of this department is based on qualities of material and workmanship described in the model specification.

Economy

5.4 Engineering services should be designed to obtain the optimum benefits from the capital invested. Where alternative design solutions are available their consequential capital and running costs should be compared using Present Worth techniques[2], due consideration being given to the need for access for maintenance and the replacement of plant and equipment.

5.5 The economic appraisal of alternative design solutions should include the heat conversion and distribution losses at the point of use. Where buildings are located remote from the development's load centre these losses can often equal the useful energy consumed.

5.6 In the interests of energy management, and where practicable, facilities should be provided at main intake points to this department for the easy attachment of energy measuring equipment, eg meters and thermometers. Engineering Data Sheet DR6[3] describes recent developments in metering techniques.

5.7 Guidance concerning the economic thickness of thermal insulation relative to the cost of energy, 'K' values, temperature differences, capital costs and hours of use is given in Engineering Data Sheet CE10.[4]

Maximum demand

5.8 User demand on engineering services is often difficult to predict but experience indicates that services designed for simultaneous peak load conditions are seldom fully utilised in practice. The estimated maximum demand and storage requirement (where appropriate) for each engineering service in this department will need to be assessed individually to take acount of building shape, geographical location, operational policies and intensity of use. As a guide and for preliminary planning purposes only the following are the estimated maximum demands for an eight-room radiodiagnostic department.

Service	Typical maximum demand	Notes
Heating ventilation DHWS (kW)	130.	
Domestic HWS (litre/sec)	1.00	Storage 1500 litre (2 hour recovery)
Cold water (litre/sec)	1.40	Storage 5000 litre (24 hours)
Supply ventilation (m^3/sec)	2.32	
Extract ventilation (m^3/sec)	2.32	Clean and dirty
Electrical (kVA)	60	Essential 30 kVA
Medical gases (litre/min)		
Oxygen	1.70	
Nitrous oxide	90	
Vacuum	650	
Fuel gas		No requirement
Steam		No requirement

Plant rooms

5.9 Recommended spatial requirements for mechanical, electrical and public health engineering services in health buildings are given in HTM 23.[5] This information is specifically intended for use during the initial planning stages and when precise dimensional details of plant are not available.

Activity data

5.10 User requirements, environmental conditions and equipment arrangements, as described in the Activity Data sheets listed in Chapter 7 should be referred to when positioning service components and outlets. Patient-operated equipment should be of the simplest pattern.

5.11 The distribution of mechanical and electrical services to final points of use should be concealed wherever possible employing the ceiling void and a 200 mm wide perimeter zone under window sills. Heat emitters should be contained within the latter and critical dimensions should be taken from the boundary of this zone. For costing purposes the 200 mm band includes the floor area occupied by minor vertical engineering ducts and is included in the building circulation provision.

Safety

5.12 Section 6 of the Health and Safety at Work etc Act 1974[6] imposes statutory duties on all persons who design, manufacture, supply, install or erect 'articles' for use at work, to ensure as far as is reasonably practicable that such articles are safe and without risk to health when properly used. Engineering systems eg pipework, terminals etc are covered by the term 'articles' and thus these duties apply to the designers of engineering services for non-domestic buildings.

Fire safety

5.13 Design guidance relative to the fire safety requirements in new health buildings is given in HTM 81.[7]* Technical information concerning the design and specification of fire detection and alarm systems is detailed in HTM 82[8] which also replaces or modifies certain clauses of BS 5839[9] Part 1 to meet the needs of health care premises. More general advice on fire protection and the fire hazards in various hospital departments including appropriate precautionary measures within a radiodiagnostic department is given in HTM 83.[10]

5.14 The design of the engineering services should accord with the recommendations in the above series of HTMs and the engineer should verify his proposals in accordance with the procedure described in paragraph 3.6.

Noise

5.15 Excessive noise in individual areas, whether internally or externally generated and transmitted, can adversely affect the operational efficiency of the department. The means of control advocated in Hospital Design Note 4[11] including its revision[12] and Engineering Data Sheet DH 1[13] should provide an acceptable acoustic environment. Care is required to ensure that there is auditory privacy in reporting and reception areas, diagnostic rooms and offices particularly where these are located adjacent to public areas.

Control access

5.16 The location of primary engineering distribution control and isolation devices should be protected against unauthorised use, eg by concealing switchgear and fuseboards in secure cupboards. They should also allow easy access from circulation rather than working areas.

Engineering commissioning

5.17 It is essential that engineering services are fully commissioned in accordance with HTM 17[14] before they are accepted for use. Flow measurement and proportional balancing of air and water systems require adequate test facilities eg orifice plates, venturi valves etc, to be incorporated at the design stage.

Mechanical services

5.18 The mechanical services include the provision of heating, ventilation, (with an option for some air-cooling) hot and cold water supplies and medical gases. For cost allowance purposes the distribution of these services is deemed to commence at their point of entry into the department and includes pipework, fittings, controls and connections to equipment and outlets.

5.19 For environmental requirements in individual spaces reference should be made to the Activity Data sheets. Recommended room temperatures, air change rates, hot water service temperatures etc are grouped under 'Technical Design Data' on each 'A' sheet. The 'B' sheets give the disposition of engineering outlets for the activities described.

Heating

5.20 General space heating requirements can be met by low pressure hot water radiators operating as a sub-system from the main heating system. Due to the complexity of electrical engineering services at high and low level, underfloor and ceiling heating are inappropriate to this department. Radiators should normally be placed under windows with sufficient clear space between the top and the window sill to prevent curtains draping over the radiator, and adequate space below to allow cleaning machinery to be used. Where a heater is located on an external wall, back insulation should be provided to limit the rate of heat transmission through the building fabric. Information regarding the construction of heat emitters including their mechanical and thermal characteristics, methods of mounting and fixing, variations in pipe connections, problems of cleaning and maintenance, means of manual control of output and aspects of safety are given in Engineering Data Sheet DN 4.[15] The surface temperature of heat emitters should not exceed 82°C.

5.21 To facilitate overall temperature control the heating system should, if practicable, be zoned relative to each major elevation of the building. Temperature controls, preferably incorporating an optimum-start feature, should include a 'silent hours' temperature set-back facility, which during commissioning should be adjusted to the lowest value consistent with providing anti-condensation heating. Time-switches should be provided to select either normal running or 'silent hours' modes for the heating and ventilation systems and their temperature controllers, with the facility for programming these services to that part of the department associated with an Accident and Emergency department separately from the remainder. The operational status of the heating and ventilating systems should be indicated by pilot lamps in, or adjacent to the space concerned, or at the reception desk for general systems, eg radiodiagnostic rooms. Manual over-rides should consist of a 'continuous on' for areas associated with the Accident and Emergency department, and a '2 hour on' facility for the remainder. These manual over-rides should be located at the reception point and be provided with labels clearly describing their function. The timing routine of the main supply and extract fans should also apply to other local extract fans serving ancillary accommodation within the same areas.

5.22 In rooms subject to significant local heat gains thermostatic radiator valves should be used. These valves should be of robust construction and selected to match the temperature and pressure characteristics of the heating system. The thermostatic head incorporating a tamper-proof facility for pre-setting maximum and minimum temperature should be controlled via a sensor located

* In preparation

integrally or remotely as appropriate. Where space is restricted or heat gains and/or losses are particularly variable, consideration should be given to the provision of thermostatically controlled fan-convectors fitted with a low-limit control.

Ventilation

5.23 Recommendations for the ventilation of individual spaces in this department are shown on Activity Data 'A' sheets. Mechanical ventilation systems are expensive in terms of capital and running costs and planning solutions should be sought which take maximum advantage of natural ventilation.

5.24 Natural ventilation is usually caused by the effect of wind pressure. It can also occur to a lesser extent if there is a temperature difference between inside and outside the building and this thermo-convective effect frequently predominates when the wind speed is low. Ventilation induced by wind pressure can promote high air change rates through a building if air is able to move freely within the space from windward to the leeward side of the building. Internal partitions, fire compartment walls and closed doorways can however often impede the flow path and when this happens the process will be more dependent on single sided ventilation. Nevertheless, even with this degree of obstruction to air movement adequate ventilation can still be obtained without necessitating large window openings, which could prejudice safety, security and comfort. Some types of windows, eg vertical sliding, can enhance single-sided air exchange by temperature difference and these will improve the overall rate of natural ventilation in protected or sheltered areas where the effect of wind is likely to be minimal. BS 5925[16]—a code of practice for design of buildings provides guidance on this subject.

5.25 It is acknowledged that planning constraints imposed by the building shape and/or functional relationships of specific areas will invariably result in some measure of deep planning. Ventilation costs can, however, be minimised by ensuring that wherever practicable core areas are reserved for rooms that require mechanical ventilation irrespective of their internal or peripheral location. Examples are, sanitary facilities, dirty utility, film processing and dark rooms, and those rooms whose clinical or functional requirements have specific environmental needs and where for reasons of privacy, absence of solar gain, avoidance of radiation scatter, etc, windowless accommodation is acceptable. Other spaces appropriate to core areas are those which have only transient occupation and therefore require little or no mechanical ventilation. Examples are circulation and storage areas.

5.26 With the restrictions imposed for radiological protection on the size and location of openable windows, the use of dim-out facilities, and the need to design for maximum flexibility of use: mechanical supply and extract ventilation will be required in each diagnostic room. Supply and extract ventilation will also be required in the film processing areas (which should be designed to maintain a negative pressure relative to adjacent radiodiagnostic rooms) and in the central reporting room. Ductwork installed above suspended ceilings of peripheral accommodation with side-wall supply diffusers and extract grilles will allow the restricted celing zone of radiodiagnostic rooms to be reserved for the lighting and X-ray power cable installations.

5.27 Ventilation supply plant should incorporate air filters of 95% efficiency against BS 2831[17] Test Dust No. 2. Filters must be readily accessible for replacement and provided with a pressure differential indicator; coarse prefilters may be justified where the intake air is exceptionally polluted. Heater batteries should be sized for the ventilation requirements only ie not the fabric loss.

5.28 The possibility of excessive heat emission from some diagnostic equipment used for fluoroscopy, ultrasound or other special and often prolonged procedures and the need for staff to wear heavy protective clothing during some procedures may require that the supply air to these rooms be mechanically cooled. (4.24) Where this option is required the plant capacity should be limited to that necessary to maintain an internal temperature of 25°C when the external ambient is 28°C. Where deep planning of other continuously occupied spaces eg offices is unavoidable there will also be occasions when acceptable levels of comfort can only be maintained by air-cooling. Planning solutions of this type however will be exceptional and no provision for cooling plant has been included in the Departmental Cost Allowance.

5.29 Air movement induced by mechanical ventilation should be from clean to dirty areas where these can be defined, with diffusers and grilles located to encourage uniform air movement within the space. The design should allow for an adequate flow of air into each space, either from the air supply system, or through grilles in doors or walls from adjacent spaces or corridors. Such arrangements however should avoid the introduction of untempered air, and should not predjudice the requirements of fire safety, radiation protection, light-proofing or privacy.

5.30 Terminal arrangements for extract systems should be protected against back pressure from external wind effects and located to avoid re-introduction of exhausted air into the building through air intakes or windows.

5.31 A separate extract system will be required for sanitary facilities, lavage areas and the dirty utility, using dual motor/fan extract unit(s) with automatic changeover facilities to ensure that these rooms are always maintained at a negative pressure, while the unit is in use.

5.32 With increasing fuel costs, and improvements in building insulation and where a local comparable heat demand exists the value of energy discharged from an extract system should be considered in relation to the cost of the recovery of such heat. For this department either a 'run around' system of heat exchangers or a plate type unit may be appropriate.

Hot, cold and drinking water services

5.33 The domestic hot water supply should be taken from the general hospital installation at a temperature not exceeding 60°C and distributed to all outlets at a temperature not less than 50°C. Outlet fittings for wash basins, sinks and shower are shown on Activity Data 'B' sheets.

5.34 Guidance concerning the design and installation of cold water supply pipework and distribution systems is given in HTM 27.[18] For frost protection purposes and to prevent condensation staining the decorative finishes all cold water pipework, valves and flanges should be insulated and vapour sealed.

5.35 Where fully potable cold water systems are not available, drinking water taps should be provided in the clean utility and the staff room. The supply to these should be direct from the mains or from a protected tank.

5.36 The particular pressure and temperature requirements for the water supply to film processors should be confirmed with the manufacturer. A minimum pressure of 1.03 bar (15 psi) is normally acceptable and the cold water temperature should not exceed 20°C. Processors should incorporate an automatic control valve to interrupt the flow of water when the processing cycle is complete.

Fire-fighting equipment

5.37 The hazards which may result from a serious fire in this department are referred to in HTM 83[10] and advice regarding the fire-fighting installation proposed should be sought from the local fire authority and agreed with the local radiation protection adviser.

5.38 Fire-fighting equipment should consist of hose-reels and portable fire extinguishers, and should be positioned so that cover is given to the whole interior of the department (but see also Para 5.39). Hose-reels, in accordance with BS 5306 Part 1[19] and usually with 30 m of hose, should be located so that the jet of water from the fully extended hose is capable of reaching every point on the floor area without interruption after due allowance is made for furniture and fittings. In addition to hose-reels 9 litre water extinguishers should be provided on the basis of one extinguisher per 200 m^2 of floor area with a minimum provision of two extinguishers per fire compartment.

5.39 Water extinguishers and hose-reels are not appropriate for fire-fighting within radiodiagnostic rooms, processor rooms and the workshop and in these areas extinguishers suitable for dealing with electrical fire risks should be provided. All extinguishers should comply with BS 5423[20] and further guidance concerning their selection and use is given in HTM 81.[7]

Piped medical gases and vacuum

5.40 Information regarding piped medical gases is given in HTM 22[21] and any subsequent published amendments. The location of outlets is indicated on the Activity Data sheets.

5.41 In the special procedures room where nitrous oxide is used provision should be made for scavenging waste anaesthetic gases. Technical information relative to anaesthetic gas disposal systems is given in Doc Eng 423.[22] Patients' recovery areas should be located to ensure adequate natural ventilation.

Electrical services

5.42 The electrical installation will include main intake switchgear and wiring and components for lighting, power, and the main supply feeders for X-ray equipment and environmental plant. Extensions from the hospital central systems for telephones (conduits only) fire alarms and staff location services, together with separate intercommunication and call systems, will also be required. These installations should comply in all respects with the current "Regulations for electrical installations"[23] and conform to the requirements of HTM 7.[24]

5.43 Reference should be made to the Activity Data sheets for the recommended levels of internal illumination, disposition of outlets for power, telephones, data transmission systems, and clocks etc in individual spaces.

5.44 The point of entry for the electrical supply will be a departmental switchroom housing the main isolators, with provision for metering, and the main distribution equipment. The switchroom will also be the distribution centre for subsidiary electrical services and, wherever possible, all equipment should be mounted at a height to give easy access from a standing position. The switchroom should be located so as to minimise the cost of cabling required to serve the department.

Electrical installation

5.45 The electrical installation in occupied areas should be concealed using PVC insulated cable in screwed steel conduit, or trunking. Steel conduit and trunking for communication systems should also be concealed wherever possible.

5.46 Guidance concerning the avoidance and abatement of electrical interference is given in HTM 14.[25] Dimming of room lighting will be extensively used in this department and care should be taken to avoid mains-borne electrical radio frequency interference affecting electro-medical equipment used elsewhere in the hospital. All dimming devices should comply with the latest issue of BS 800[26] and switch-start fluorescent luminaires should comply with BS 5394.[27]

Lighting

5.47 Practical methods of lighting the various functional spaces are contained in the CIBS Lighting Guide[28] and the choice of luminaire (lighting fitting) should take account of the requirements of light distribution, and visual comfort appropriate to the space. Luminaires should be of a type which are easily cleaned and maintained. Their location should be readily accessible for lamp changing and maintenance but with the over-riding requirement that the recommended standard of illumination is provided to the task areas. Luminaires using fluorescent lamps should be installed when artificial lighting is required for long periods; intermittently-used luminaires may be fitted with tungsten or compact fluorescent lamps. For further information concerning standard reference luminaires for use in health care buildings, see Engineering Data Sheet DE 1.[29]

5.48 It is essential that fluorescent lighting in clinical areas is derived from one of the recommended types of lamps having suitable colour rendering characteristics.[30] In such areas the colours chosen for walls, floors and ceilings should be carefully selected; architects and engineers should collaborate to ensure that the decorative finishes are compatible with the colour rendering properties of the

lamp and that spectral distribution of the resulting luminous flux is not adversely affected.

5.49 Control of lighting is normally by local switches and these should be provided in sufficient numbers to allow variation in lighting intensity eg reduced levels of illumination when circumstances permit, and to encourage energy conservation. This is particularly relevant in rooms where, because daylight is restricted, supplementary artificial lighting is required for long periods in areas remote from windows. Although Activity Data 'A' sheets often recommend higher standards of illumination for spaces that are deep-planned, excessive contrast with adjacent areas outside the hours of daylight should be avoided.

5.50 In addition to the general lighting a safe-light installation should be provided in dark rooms and (to facilitate recovery of unexposed film) in areas containing automatic film loaders or dispensers. The safe-light installation in dark rooms should be controlled by a change-over switch to ensure that if the unused film hopper is opened the general lighting is extinguished. An 'In use' warning sign should be provided outside the entrance to dark rooms. The sign should be automatically illuminated when the safe-light system is in use.

Radiodiagnostic rooms

5.51 The ceilings of these rooms should incorporate equipment support facilities (4.26) consisting of a grid of uniformly spaced universal type support channels of a proprietary nature, the dimensions between which are co-ordinated to accommodate recessed modular fluorescent luminaires. Such an arrangement allows a compromise between the masking of lighting by mobile ceiling-mounted equipment, and the need for well positioned task illumination. The lamps in the modular luminaires should be circuited and switched to provide two stages of intensity (100% and 50%) and for lower levels of illumination the luminaires should also incorporate tungsten lamps controlled by a single dimming device. These overall arrangements with all lighting control and isolation adjacent to the X-ray control console, and with the main lighting 2-way switched at the doorways, will readily accommodate relocation of luminaires when changes are made to the main equipment.

Illuminated signs

5.52 At each entrance to a radiodiagnostic room, except entrances used only by patients under the direct control of staff already inside the room (eg those from walk-through changing cubicles), a safety sign (see paragraph 2.11) and a warning lamp must be provided. The warning lamp should give a clear indication in red when it is energised and may incorporate the legend 'Do not enter', visible only when illuminated. All warning lamps should have incandescent filaments energised from a suitable power source within the room and switched via appropriate devices interfaced with the operation of the diagnostic equipment.

Corridor lighting

5.53 The lighting of corridors and circulation areas, not covered by Activity Data sheets, should be to a minimum intensity of 100 lux at floor level. Mounting luminaires longitudinally along a corridor, centrally, or to one side to assist compliance with glare limitations is acceptable, as is the occasional transverse luminaire to mark corridor junctions or unavoidable changes in floor level.

Controlled Drugs cupboards

5.54 In compliance with HC (77)16[31] a red indicating lamp should be provided on each Controlled Drugs cupboard, with remote indicating lamps where appropriate at: the doorway to the room in which the cupboard is located, the corresponding nurse base, and after hours, in a continuously manned area external to the department. The lamps should be interlocked with the cupboard to give visual indication when the cupboard is unlocked and should be supplied from an essential circuit. For further information see MDB Booklet 5/1[32] and its associated specification for electrical services.

Socket outlets

5.55 Sufficient 13 amp universal type switched, shuttered socket outlets, connected to ring or spur circuits should be provided to allow all portable appliances likely to be used simultaneously to be individually supplied. Activity Data sheets indicate specific locations for the outlets associated with individual activities; the installation of twin outlets should be considered where these activities occur in juxtaposition. In radiodiagnostic rooms, recovery areas and wherever X-ray films are processed, reported on, or stored, socket outlet systems should be planned so that a supply is available in the space from at least two separately fused circuits of common phase.

5.56 Domestic cleaning appliances with flexible leads nine metres long should be assumed and socket outlets, usually in corridors, should be provided to enable such machines to operate over the whole area of the accommodation.

5.57 Permanently connected appliances rated up to 13 amps should be supplied from double pole switched spur boxes and fused as required. Appliances rated in excess of this load, or those requiring a three-phase supply, should be permanently connected to separate final circuits from fuseboards and independently switched.

5.58 Switches or other means of isolation should be provided adjacent to electrical machinery and plant to ensure the safety of operators and maintenance staff.

5.59 Heating appliances and automatically operated equipment should be provided with indicator lights to show when the equipment is energised. Such indicators should be incorporated in the control panel of the apparatus, in the control switch, or in the outlet from which the apparatus derives its supply.

5.60 The electrical supply connections to all classes of electromedical equipment including radiodiagnostic equipment should comply with BS 5724[33] and the equipment itself should comply with this British Standard.

5.61 Advice on the power supply requirements for fixed radiodiagnostic equipment is given in HTM 7,[24] paragraph 111, and for mobile equipment in paragraph 185. Individual project requirements, including the relative arrangements of rooms within the department, will largely decide whether a spur or ring type feeder system is appropriate. While lower circuit impedance favours the ring circuit, difficulty in looping heavy current cables at the

terminals of switchgear should be borne in mind. The sharing of final feeders between several diagnostic rooms should take account of the diversity of usage, with particular reference to exposure duration and frequency; the lowest diversity being accorded to the equipment used for fluoroscopy and special procedures. Power terminations within radiodiagnostic rooms should consist of an isolator when connected to a spur feeder, and a fused switch when connected to a ring feeder.

5.62 Numerous electrical interconnections are required between the separate components associated with a complete radiodiagnostic room installation. Conduit and cable trunking should preferably be installed by the electrical sub-contractor, to a layout satisfying the requirements of the equipment supplier who will normally supply and install the interconnections. Some cables have limitations on maximum length and radius of bends, eg high-voltage cables. While it is preferable for all the components associated with a radiodiagnostic room to be located therein, the relative positions will depend on operational requirements and room features. Control consoles and control equipment cabinets however are usually located adjacent to, or against perimeter walls. With these features in mind, the cable distribution may be accommodated in a perimeter floor duct located approximately 200 mm from the walls, from which spur ducts traverse the floor to island equipment, or rise via wall-mounted units to terminate at cable trunking above the ceiling. Floor trunking should be of the continuous lid load bearing variety of nominal 100 mm depth. Changes in direction of trunking should be provided with an internal angle gusset, and all trunking lids when removed should give total access so that cables may be laid in, rather than drawn into the trunking, without negating the possibility of drawing in individual cables during periodical maintenance by lifting lids only at angles or tees. Should it be necessary for trunking to pierce walls etc, then there should be adequate straight sections either side of the wall to enable preformed cable termination assemblies to be fed through such an opening without difficulty. The surface finish of cable trunking visible within radiodiagnostic and ultrasound rooms should be commensurate in quality with the equipment consoles and cabinets. Conduit or trunking routes piercing radiological barriers, eg radiodiagnostic room perimeter walls, should be provided with adequate radiation shielding or dense in-fill material.

Emergency electrical supplies

5.63 Guidance on the provision of emergency electrical supplies is given in HTM 11[34] and the grade of standby lighting provision is shown on the Activity Data 'A' sheets. Safety lighting in accordance with HTM 11[34] and BS 5266[35] should be provided on primary escape routes.

5.64 All socket outlets in reporting areas and in areas provided with Grade A standby lighting together with the power supply to one film processor and all communication, clock and alarm systems in this department should be capable of being automatically transferred to the hospital standby generation system. Preferably one socket outlet in each radiodiagnostic room should be capable of supplying a mobile X-ray unit at full power, during the periods that the normal mains supply is not available for any of the main X-ray equipment. It may not be possible for small generator sets (of 100 kVA rating or less) to provide full power to a mobile X-ray unit, even if the distribution circuit to the socket outlet complies with HTM 7[24] paragraph 185. Regardless of the size of the generator it is advisable therefore to check with the standby generator set manufacturer that the set is capable of (a) supplying the necessary mains current via a 0.34 ohm external circuit impedance and (b) supplying it for the required X-ray exposure period without tripping the short-circuit protection provided at the generator set. It is even more important that this be checked if consideration is being given to the connection of any main X-ray units to the generator.

Intercommunication system

5.65 The location of intercom stations is indicated on Activity Data 'A' sheets. The stations should be the 'duplex' type, ie microphone and loudspeaker combined in a telephone type instrument, with automatic voice switching and automatically convertible to 'telephone mode' for privacy. The system should provide a minimum of two speech channels and incorporate an all-call paging system. An intercom station will also normally be required in an adjacent Accident and Emergency department.(2.19c)

Patient staff call system

5.66 A call point should be provided in all patient areas including diagnostic rooms, WCs and changing accommodation and should comprise a push-button, reassurance lamp and reset switch. A visual and audible indication of operation should be provided at the nurse base and repeated at the main reception point to give responding staff unambiguous identification of the call source. For use outside normal working hours switching should be provided to transfer indication of an emergency call to the Accident and Emergency department or to an appropriate centrally manned point. Further guidance is given in HTM 15.[36](2.19b)

Staff location system

5.67 The staff location system employed in the hospital should be extended to give adequate cover to this department. Guidance on these systems is given in HTM 20.[37](2.19d)

Wireways for telephones etc

5.68 Central telephone facilities for internal and external calls, either in separate or combined form, will normally be available and should be extended to serve this department in accordance with the requirements shown on Activity Data sheets. Telephones will normally be of the desk pattern but in recovery areas, or adjacent to them, they should be fitted with an indicating call-light and a bell or buzzer of subdued tone.

5.69 In addition to conduits for telephone and intercom cables separate wireways will be required for signal cables interconnecting electronic equipment. These wireways should link all rooms (a) where diagnoses are undertaken or viewed eg diagnostic rooms and reporting areas (b) where used films are stored and where patient records are processed and (c) where closed-circuit television supervision is envisaged.

Electric clocks

5.70 Clocks should operate in conjunction with a master clock system. If such a system is not available synchronous clocks should be installed using a common clock circuit suitable for future connection to a master system. A clock with a sweep second hand should be installed in each diagnostic room. Elsewhere the number of clocks provided should be kept to the minimum and they should be installed only where they can be viewed by numbers of staff/patients/visitors.

Fire alarm and detecting system

5.71 A monitored open-circuit system which allows the connection of break-glass call points and automatic detectors is recommended. The choice of detectors is a complex matter but the types appropriate to this department are specified in the guidance already mentioned in paragraph 5.13. It should be noted that if automatic doorholders are used on escape routes then optical type smoke detectors must be used.

5.72 Audible alarms should be used throughout the department with the exception of the radiodiagnostic rooms used for special procedures where a visual alarm supplemented by a buzzer of low sound level should be used. The number of sounders provided should be sufficient to ensure adequate audibility. (HTM 82 (Appendix 5))[8]

Lightning protection

5.73 Protection against lightning should be provided in accordance with HTM 7[24] and HSE Data Sheet DB 2.[38]

Internal drainage

5.74 The primary objective is to provide an internal drainage system that uses the minimum of pipework and remains water and air-tight at joints and connections, but is sufficiently ventilated to retain the integrity of water seals. Providing that there is adequate dilution and the silver content has been recovered the effluent (fixer and developer) from film processors can be discharged into the internal drainage system.

5.75 General design guidance is given in the relevant British Standards and Codes of Practice including BS 5572—formerly CP 304,[39] and the current Building Regulations. Recommendations regarding spatial and access requirements for public health engineering services are given in HSE Data Sheet EA5.[40] Accessibility for drain rodding is particularly important where the effluent contains barium or film residue, but the system should be designed to avoid the necessity for internal manholes.

5.76 The gradient of branch drains should be uniform and adequate to convey the maximum discharge to the stack without blockage. Practical considerations such as available angles of bends/junctions and their assembly, as well as spatial considerations, usually limit the minimum gradient to about 1:50 (20 mm/m). For the larger pipes, eg 100 mm diameter, flatter gradients can be used but require workmanship of a high standard if adequate self-cleansing flow is to be maintained. It is not envisaged that pipes larger than 100 mm diameter will be required within interfloor or ground floor systems serving this department.

5.77 Bedpan macerators should discharge with a short branch to a vertical stack or horizontal drain. The waste should not be installed above or close to heating or domestic hot water mains. If the macerator discharges to a 100 mm horizontal drain then frequently-used large volume appliances should be situated up-stream of its connection to provide additional flushing to help prevent resinuous sludge accumulating in the drain.

5.78 Where appropriate particular attention should be given to the design and accessibility of traps and flushing apparatus to permit cleaning of barium from the drainage system.

5.79 The materials specified for the drainage system in this department will depend upon their location and the nature of the effluent eg corrosive chemicals, being discharged. Although adequate for the drainage requirements UPVC may not always be acceptable to the fire officers and neither should it be installed above 'sensitive' areas, eg Operating, Intensive Therapy, or Catering departments etc.

Engineering references

1. **Department of Health and Social Security.** Health Service Engineering Data Sheets CS 1 to CS 42. Standard specifications and contract documents.

2. **Department of Health and Social Security.** Engineering Division. An introduction to Present Worth techniques (enclosure to DS 173/73). London DHSS, 1972. 27pp. and Present Worth approach to decision taking. London DHSS, 1973. 34pp.

3. **Department of Health and Social Security.** Metering of energy and water consumption services (DHSS Engineering Data Sheet DR6) London DHSS, 1980. 14pp.

4. **Department of Health and Social Security.** Economic thickness of thermal insulation for pipe work and air ducts. (DHSS Engineering Data Sheet CE 10) London DHSS, 1981. 32pp.

5. **Department of Health and Social Security.** Access and accommodation for engineering services (Hospital Technical Memorandum 23) London, HMSO, 1972. 36pp.

6. **Health and Safety at Work etc Act. 1974.** HMSO.

7. **Department of Health and Social Security.** Fire safety in health care premises—Planning and design of new buildings (Health Technical Memorandum 81) London, HMSO. (In preparation)

8. **Department of Health and Social Security.** Fire alarm systems in health buildings (Health Technical Memorandum 82) London, HMSO.

9. **British Standards Institution.** BS 5839: 1980. Fire detection and alarm systems in buildings; Part 1. Code of Practice for installation and servicing (Revision of CP 1019).

10. **Department of Health and Social Security.** Fire safety in health care premises—General fire precautions (Health Technical Memorandum 83) London, HMSO.

11. **Ministry of Health.** Noise control. (Hospital Design Note No 4) London, HMSO, 1966. 20pp.

12. **Department of Health and Social Security.** Health services management—Noise control. (Hospital Design Note 4): amendments to appendices II, IV and VIII. (HN(76)126) London, DHSS. 2pp.

13. **Department of Health and Social Security.** Noise and vibration (DHSS Engineering Data Sheet DH 1) London DHSS, 1977. 24pp.

14. **Department of Health and Social Security.** Health building engineering installations: Commissioning and associated activities (Health Technical Memorandum 17) London, HMSO, 1978. 6pp.

15. **Department of Health and Social Security.** Heat emitters (DHSS Engineering Data Sheet DN4) London DHSS, 1978. 87pp.

16. **British Standards Institution.** BS 5925: 1980. Code of practice for design of buildings: ventilation principles and designing for natural ventilation. (Revision of CP3: Chapter 1(c)).

17. **British Standards Institution.** BS 2831: 1971. Methods of test for air filters used in air conditioning and general ventilation. 44pp.

18. **Department of Health and Social Security.** Cold water supply: storage and mains distribution. (Health Technical Memorandum 27) London, HMSO, 1978, 74pp.

19. **British Standards Institution.** BS 5306. Code of Practice for fire extinguishing installations and equipment in premises. Part 1: 1976. Hydrant systems, hose reels and foam inlets. 16pp.

20. **British Standards Institution.** BS 5423: 1977. Specification for portable fire extinguishers. 16pp.

21. **Department of Health and Social Security.** Piped medical gases, medical compressed air and medical vacuum installations (Health Technical Memorandum 22) London, DHSS, 1977. 92pp.

22. **Department of Health and Social Security.** DHSS/Regional Engineers Association. Technical information on anaesthetic gas disposal systems (Doc Eng 423) DHSS, 1981. 62pp.

23. **Institution of Electrical Engineers.** Regulations for electrical installations. 15th edition, 1981. 216pp.

24. **Department of Health and Social Security.** Electrical services: supply and distribution. (Health Technical Memorandum 7) London, HMSO, 1977. 48pp.

25. **Ministry of Health.** Abatement of electrical interference. (Hospital Technical Memorandum 14) London, HMSO, 1965. 26pp.

26. **British Standards Institution.** BS 800: 1977. Specification for interference limits and measurements for equipment embodying small motors, contracts, control and other devices causing similar interference. 28pp.

27. **British Standards Institution.** BS 5394: Part 1. Radiated interference limits and measurements for lighting equipment.

28. **Chartered Institution of Building Services.** Lighting guide: hospitals and health care buildings. Publication No 12, CIBS. 1979. 80pp.

29. **Department of Health and Social Security.** Standard reference luminaires for hospital and health building use (DHSS Engineering Data Sheet DE1) London, DHSS, 1978. 36pp.

30. **Department of Health and Social Security.** Electrical lighting specification for good colour rendering fluorescent light course suitable for hospital lighting. (Hospital Services Engineering Data Sheet DE 2.1) London, DHSS, 1979. 4pp. and good colour rendering: fluorescent lighting in health buildings. (HN(79)39) London, DHSS, 1976. 2pp.

31. **Department of Health and Social Security.** Health services management. Misuse of drugs regulations 1973 [HC(77)16] London, DHSS, 1977. 3pp.

32. **Department of Health and Social Security.** Manufacturers Data Base. Storage and Worktop Units 5/1—revised 1973 range. DHSS, 1975 (Amended 1976).

33. **British Standards Institution.** BS 5724: Part 1: Specification for safety of medical electrical equipment: General requirements.

34. **Department of Health and Social Security.** Emergency electrical services. (Hospital Technical Memorandum 11) London, HMSO, 1974 revised. 33pp.

35. **British Standards Institution.** BS 5266: Part 1. Code of Practice for emergency lighting of premises.

36. **Ministry of Health.** Staff location systems. (Hospital Technical Memorandum 15) London, HMSO, 1966. 30pp.

37. **Ministry of Health.** Staff location systems. (Hospital Technical Memorandum 20) London, HSMO, 1968. 10pp.

38. **Department of Health and Social Security.** Lightning protection for hospitals (Hospital Service Engineering Data Sheet DB2) London, DHSS, 1971. 7pp.

39. **British Standards Institution.** BS 5572: 1978. Code of Practice for sanitary pipework (formerly CP 304). 56pp.

40. **Department of Health and Social Security.** Horizontal and vertical drainage—access and accommodation. (Hospital Service Engineering Data Sheet EA 5.1) London, DHSS, 1975/1978. 19pp.

6 Cost information

6.1 For all types of health buildings it is clearly of vital importance that building costs and running costs should be kept as low as possible consistent with acceptable standards. Within this general context building notes provide a synopsis of accommodation for health buildings which the Department, in conjunction with the National Health Service, recommends for the provision of a given service.

Departmental cost allowance (DCA)

6.2 To prepare the DCA for a scheme reference should be made to the current edition of Appendix 7 to Hospital Building Procedure Note 6 – Capricode. The total DCA for any scheme is derived by aggregating the cost of the functional units together with any Essential Complementary Accommodation and Optional Accommodation/Services appropriate to the particular scheme. An example is given in the Health Notice associated with this Note.

6.3 The DCA covers the building and the engineering requirements set out in this Note. In the costing of the functional units it has been assumed that they will be incorporated into a whole hospital to form a complete department.

6.4 The functional units for this Note are:

Department comprising:

a. Four
b. Five
c. Six
d. Seven
e. Eight
f. Nine
g. Ten
h. Eleven
i. Twelve

} diagnostic rooms

The activity spaces for each functional unit are listed in the 'basic accommodation' schedule at the end of this chapter.

Dimensions and areas

6.5 In determining spatial requirements, the essential factor is not the total area provided but the critical dimensions, ie those dimensions critical to the efficient functioning of the activities which are to be carried out. (3.16) There are therefore no recommended areas associated with the schedules of activity spaces. To assist project teams in preparing detailed design solutions for the rooms and spaces, studies have been carried out to establish dimensional requirements in the form of critical dimensions. The results of these studies appear as ergonomic diagrams in Appendix VIII of this Note and in the 'Common Activity Spaces' Health Building Note.

6.6 It is recognised that for development planning and at the earliest stage of a departmental design, it may be convenient for designers to have data available which will enable them to make an approximate assessment of the sizes involved. For this reason the schedules of areas which have been prepared for the purposes of establishing the DCA, are included with the health notice promulgating the DCA for this Note. It is emphasised that the areas published DO NOT represent recommended room sizes nor specific individual entitlements.

Circulation

6.7 The schedule of areas used for costing (6.6) will have an area for circulation, within each functional unit, shown as an addition. It should be noted that for convenience the areas allowed for planning provision, engineering zone and for partitions are included in the area allowed for circulation.

Radiodiagnostic department

6.8 A DCA, which includes the necessary processing facilities, has been provided for each of nine sizes of department. (6.4) The ancilliary accommodation listed in the 'basic accommodation' schedule is included in each size. Any additional accommodation provided by either Essential Complementary or Optional Accommodation or both, will need to be added to form the total building cost. (6.13, 6.14)

6.9 Two sizes of diagnostic rooms are provided for in the DCA; one size for use as a general purpose room and a larger one for more specialised examinations. For DCA purposes it has been assumed that in departments with an even number of radiodiagnostic rooms, there will be an equal number of each size of room. In departments with an odd number of rooms there will be one fewer of the larger type.

6.10 The DCA assumes the use of a computer system for the master index. (3.18) See paragraph on optional accommodation/services for manual storage systems. (6.13)

6.11 The DCA assumes that current film storage, sorting/collating and despatch/return are a single space. (3.9)

6.12 In addition to the basic accommodation the DCA also covers support steelwork for overhead equipment together with a suspended ceiling (4.25) and a floor with increased thickness of screed, (4.31 and Option 1 of Appendix IV) in each radiodiagnostic room.

Essential complementary accommodation (ECA)

6.13 This comprises activity spaces which are essential to the running of the department but which in certain cir-

cumstances may be available in a convenient location elsewhere in the hospital. The amount of ECA which will need to be provided as part of an individual project will therefore vary according to the extent of the provision available elsewhere. The ECA costed in this Note is listed in the Schedule at the end of this chapter.

Optional accommodation/services (OAS)

6.14 This Note, where appropriate, draws attention to alternative ways of providing services or facilities, including the likely cost implications. This information will enable project teams to select the solution which is most suitable to their needs. The OAS costed in this Note is listed in the schedule at the end of this chapter.

6.15 If more radiologists are employed in the department than are allowed for in the basic accommodation the cost of additional office and typist space will be provided under OAS.

6.16 The following OAS discussed in this Note have not been costed:

a. Pass-through changing cubicles (4.15)
b. Manual processing (4.47)
c. Centralised chemical supply (4.55)
d. Accommodation for trainee radiologists or radiography students (1.5c)
e. Centralised silver recovery (Appendix VII)
f. Lightweight modular access floor (Option 2 of Appendix IV)
g. Load bearing modular access floor (Option 3 of Appendix IV).

Communications—plant space

6.17 Plant rooms, with the exception of an electrical switchroom and a standard enclosure for medical gas isolation points, are not included in the DCA.

Engineering services

6.18 The following engineering services as described in the Engineering Chapter and exemplified in Activity Data are included in the DCA. Primary enginering services are assumed to be conveniently available at the boundary of the department.

a. *Mechanical services*

Heating: low pressure hot water system, maximum touch temperature 82°C with zone control

Ventilation: mainly natural, but with a mechanical supply and extract to meet clinical and functional requirements

Optional provision of air cooling in some diagnostic rooms

Cold water service: centrally supplied to service points including drinking water and hose-reels (storage tanks excluded)

Hot water service: centrally supplied at 60°C (storage excluded)

Medical gas: piped supply of oxygen, nitrous oxide and vacuum from the hospital centralised system. Waste gas scavenging system in each special procedures diagnostic room.

b. *Electrical services*

Departmental distribution switchboard

General lighting as required by tasks

Fluorescent, tungsten, safe-light and emergency lighting fittings as appropriate

Socket-outlets and other power-outlets for fixed and portable equipment

Standby and safety installation from the main hospital supplies

Intercommunication system

Patient/staff call system

Telephone and data transmission conduits only

Staff location extension to the hospital system

Impulse clocks

Fire, medical gas and drug cupboard alarm systems

c. *Equipment (Group 1)*

Water boilers, bedpan liner disposal units or bedpan washers with integral steam generator.

SCHEDULES OF ACTIVITY SPACES

Activity space	*Number of rooms*								
Basic Accommodation	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
1 Reception/appointment/indexes	1	1	1	1	1	1	1	1	1
2 Patients' main waiting area	1	1	1	1	1	1	1	1	1
3 Bed/trolley/wheelchair/waiting area	1	1	1	1	1	1	1	1	1
4 Porters' base	1	1	1	1	1	1	1	1	1
5 Current film storage, sorting/collating and despatch/return	1	1	1	1	1	1	1	1	1
6 Patients' sub-waiting area	1	2	2	3	3	4	4	5	5
7 Patients' sub-waiting area—accident and emergency	1	1	1	1	1	1	1	1	1
8 Changing cubicles—ambulant	9	11	13	16	18	21	23	25	27
9 Changing cubicles—assisted	2	3	3	3	4	4	5	5	6
10 Diagnostic rooms—general	2	3	3	4	4	5	5	6	6
11 Diagnostic rooms—specialised procedures	2	2	3	3	4	4	5	5	6
12 Patients' holding and recovery, clean utility and nurse base	1	1	1	1	1	1	1	1	1
13 Dirty utility	1	1	1	1	1	1	1	1	1
14 Lavage rooms—trolley	1	1	1	1	1	1	1	1	1
15 Lavage rooms—ambulant	—	—	—	—	—	1	1	1	1
16 Patients' WCs—barium enema	2	2	2	2	2	2	2	2	2
17 Patients' WCs—ambulant	2	3	4	4	5	5	6	6	7
18 Patients' WCs—wheelchair	1	1	1	1	1	2	2	2	2
19 Daylight automatic processing, viewing, checking and immediate reporting area	1	2	2	3	3	4	3	4	4
20 Ditto, with dark room	1	1	1	1	1	1	2	2	2
21 Radiologists' offices	1	1	2	3	3	4	4	5	5
22 Radiologists' office/clinical conference room	1	1	—	—	—	—	—	—	—
23 Central reporting/diagnostic conference room	—	—	1	1	1	1	1	1	1
24 Secretary typist	1	1	1	1	1	1	1	1	1
25 Typists' accommodation			1	1	1	1	1	1	1

Activity space	*Number of rooms*								
Basic Accommodation	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
26 Superintendent radiographer's office	1	1	1	1	1	1	1	1	1
27 Cleaners' room	1	1	1	1	1	1	1	1	1
28 Equipment store	1	1	1	1	1	1	1	1	1
29 Unused film store	1	1	1	1	1	1	1	1	1
30 Chemical store	1	1	1	1	1	1	1	1	1
31 Linen store	1	1	1	1	1	1	1	1	1
32 Mobile X-ray equipment parking bay	1	1	1	1	1	1	1	1	1
33 Switchroom	1	1	1	1	1	1	1	1	1
34 Staff room	1	1	1	1	1	1	1	1	1
35 Staff changing—male	1	1	1	1	1	1	1	1	1
36 Staff changing—female	1	1	1	1	1	1	1	1	1
37 Staff WCs	2	2	2	2	2	3	3	4	4
38 Shower	1	1	1	1	1	1	1	1	1

Essential Complementary (ECA) or Optional Accommodation/Services (OAS)

Activity space or service	*Number of rooms*
Essential complementary accommodation	
1 Seminar room (20 persons)	1
2 Workshop	1
Optional accommodation/services	
1 Darkroom	1
2 Lavage room, ambulant	1
3 Special procedures changing	1
4 Anaesthetic room/bay	1
5 Barium preparation area	1
6 Radiologist's office	1
7 Typist's space	1

7 Activity data

7.1 The expression 'Activity Data' refers to an information system developed to help project and design teams by defining the users' needs more precisely. This information constitutes the Activity Data Base, which was issued to Regional Health Authorities in England and to the Health Departments in Scotland, Northern Ireland and Wales in 1976. It comprises two types of information sheet: Activity Space Data Sheets (known as 'A' sheets) and their supporting Activity Unit Data Sheets (known as 'B' sheets).

7.2 'A' sheets record in more detail than is described in this Note each task or activity that is performed in a particular activity space (which may be a room, space or bay) together with details of the environmental conditions and the technical data necessary to enable the activities to be performed. Each 'A' sheet also contains a list of the titles and code numbers of the relevant 'B' sheets which give both in narrative text and in graphics to scale, equipment fitted or supplied as part of the building and engineering terminals which satisfy the required user activities.

7.3 Further information about the use and preparation of Activity Data can be found in the 'Guide to 'A' and 'B' Activity Data Sheets and their use in Health Building Schemes' which was issued to Regional Health Authorities in June 1980 and to NHS Authorities in Wales in November 1980. Copies of the Guide are available from the Department's Directorate of Works Development, Branch Dev 1.2, Euston Tower, 286 Euston Road, London NW1 3DN.

Activity data applicable to this Note

7.4 The 'A' and 'B' sheets recommended for the activity spaces described in this Note have been newly prepared or selected from existing sheets. Their code numbers and titles are provided on the lists which follow. However, in the case of diagnostic rooms, radiological equipment has not been listed on the 'A' sheets. This is due to differing requirements and to the multiplicity of combinations of radiological equipment in a particular room. The lists of 'B' sheets contain, nevertheless, the 'B' sheet numbers of the radiological equipment listed in Radiodiagnostic Equipment Note No 6.

7.5 Further Activity Data sheets may be selected, or drawn up by project teams to their own requirements, for any services not described in the Note or included in the list. Members of project teams are advised to contact their Regional Activity Data Coordinator/Welsh Office for information and advice about the selection of activity data at an early planning stage. However, in order to ensure consistent and economic provision, variations from the 'A' sheets recommended for the spaces covered in this Note should be considered only where it has been decided that the function of a space will substantially differ from that described.

LIST OF ACTIVITY DATA 'A' SHEETS

Activity space		*'A' sheet code no*				*para number in building note*
Reception/appointments area Master index/report index/diagnostic index	}	J0605				4.3 4.8
Patients' main waiting area		J1102		J1104	J1105	4.5
Bed/trolley/wheelchair waiting area		G0202				4.6
Porters' base		M1706				4.7
Current film storage		W0307		W0308	W0309	4.9
Patients' sub-waiting area		J1212		J1213		4.13
Changing cubicles		V0703		V0706		4.15
Diagnostic rooms		E0501	E0502	E0503 E0505	E0504	4.18
Nurse base		T0109				4.38
Clean utility		T0506		T0509		4.39
Patients' holding and recovery area		T0203				4.40
Dirty utility		Y0408				4.42
Lavage rooms		X0505		X0506		4.43
Patients' WCs	C	V1106		V1204	V1219	4.44
Daylight automatic processing		E0508				4.49
Daylight automatic processing with dark room facility		E0507				4.54
Viewing, checking and immediate reporting area						4.58
Sorting and collating area		E0512		E0513	E0514	4.62
Radiologists' offices		M0303		M0309		4.66
Central reporting room/diagnostic conference room		E0510		E0509		4.68
Clerical accommodation		M1014		M1015	M1306	4.74
Film despatch and return		E0511				4.75
Superintendent radiographer's office		M0508				4.76
Cleaners' room	C	Y1501				4.77
General store		W0310				4.78
Unused film store		W0303				4.79
Chemical store		W0306				4.80
Linen store		W0301				4.81
Mobile X-ray equipment parking bay		G0101				4.82
Switchroom		K0101				4.83
Staff room		D0203		D0204	D0205	4.84
Staff changing and WCs		V0509		V0510	V0511	4.85
	C	V1005		V0512	V0513	
Shower	C	V1606				4.89
Seminar room*		H0102				4.90
Workshop*		K0303				4.91
Special procedures changing room†		V0509				4.92
Anaesthetic room/bay†		E0506				4.93
Barium preparation area†		X0507				4.94
Additional dark room†		R0106				4.95

* ECA
† OAS
C Common Activity Spaces

'B' Sheet Code No	*Activity Unit Title*
A02AH	CLEANSING Clinical handwashing
A05BK	PREPARATION/STORAGE Controlled drugs and supplies, radiodiagnostic
A05CC	PREPARATION/STORAGE Chiropody/dental/radiodiagnostic materials
A19AI	SUPERVISION/CONTROL Staff base, ward
A22BI	EXAMINATION Colonic lavage apparatus
A27AB	ASSESSMENT Viewer X-ray film, double
A27AT	ASSESSMENT X-ray illuminator, quadruple, on mobile stand
A27AU	ASSESSMENT X-ray illuminator, quadruple, 600 mm work bench
A31BM	RADIOLOGY Syringe injector, automatic
A31BP	RADIOLOGY Cassette storage chest, mobile
A31BW	RADIOLOGY TV monitor, wall mounted, swivel
A31BX	RADIOLOGY Screen, lead rubber, mobile
A31CA	RADIOLOGY Processing, silver recovery
A31CE	RADIOLOGY X-ray film processor, automatic
A31CG	RADIOLOGY Radiodiagnostic table, accessories storage rack
A31CH	RADIOLOGY X-ray film storage rack
A31CI	RADIOLOGY Film reporting station with multiple viewing panel
A31CJ	RADIOLOGY Cassette hatch
A31CM	RADIOLOGY Bench with X-ray illuminator inset
A31CP	RADIOLOGY Film reporting station with worktop and illuminators
A31CT	RADIOLOGY Processing chemical mixer, automatic
A31DO	RADIOLOGY X-ray unit, mobile, motorised
A31DS	RADIOLOGY Protective apron rack
A31EF	RADIOLOGY Daylight film dispenser
A31EM	RADIOLOGY Film reporting station, worktop with 4 TV monitors
A31EN	RADIOLOGY Workbench, storage unit and illuminators, 1 high intensity
A31EO	RADIOLOGY Film reporting station single TV monitor
A31EP	RADIOLOGY Worktop 2400 × 900 mm with storage units under
A31ER	RADIOLOGY X-ray film processor, automatic, small film
A31ES	RADIOLOGY Film and record storage
A31ET	RADIOLOGY Film reporting station, radiologist
A31EU	RADIOLOGY X-ray film processor, automatic, with integrated dispenser
A38AD	ANAESTHESIA General anaesthetic apparatus trolley
A38AL	ANAESTHESIA Anaesthetising unit, wall mounted, service outlets
A38AP	ANAESTHESIA Storage cupboards, drugs and anaesthetic sundries
B01AU	CHANGING Patient categories 1–4, with chair
B01AV	CHANGING Cubicle, patient categories 1–3, with wall mounted seat
B02BI	CLEANSING Sink unit with cupboard
B02CK	CLEANSING Sink unit and drainer, large London sink, low level 250 × 925 × 500 mm
B04BY	STORAGE Cupboard 1800 × 900 × 450 mm steel, lockable
B04FX	STORAGE Cupboard 600 × 500 × 300 mm wall mounted, 1 shelf
B04HA	STORAGE Clean and sterile supplies, 9 basket rack, 3 trolleys and 3 shelves over
B04JE	STORAGE Key cupboard, 30 hooks
B04KB	STORAGE Cupboard stationery 900 × 900 × 450 mm
B04PC	STORAGE Cupboard 600 × 1200 × 300 mm, wall mounted, 2 shelves
B05BP	PREPARATION/STORAGE Worktop, 1200 × 600 mm, 2 drawers, 1 cupboard under

LIST OF ACTIVITY DATA 'B' SHEETS

'B' Sheet Code No	*Activity Unit Title*
B05BR	PREPARATION/STORAGE Worktop, 1800 × 600 mm, sink unit, 2 cupboard under and socket outlet
B05BX	PREPARATION/STORAGE Worktop, 2700 × 600 mm, 3 drawer/cupboard units under, 3 cupboards over
B05CM	PREPARATION/STORAGE Worktop, 2700 × 600 mm, 3 drawer/cupboard units under
B06CO	PREPARATION Beverages with small domestic electric cooker, refrigerator
B09BE	DISPOSAL Bedpan disposal unit, departmental
B11AZ	RECEPTION Counter, privacy control
B11BC	RECEPTION Counter departmental, 2 receptionists, no intercom
B12EK	PROCESSING Label printer
B14AD	ADMINISTRATION Desk double pedestal with chair, telephone and socket outlet
B14AU	ADMINISTRATION Desk single pedestal with chair
B15AI	SECRETARIAL Desk unit, with telephone and socket outlet
B16AA	COMMUNICATION·Telephone, wall mounted, with writing shelf
B23AA	INFORMATION TECHNOLOGY Visual display unit
B23AB	INFORMATION TECHNOLOGY Computer line printer
B24AF	EDUCATION Projector screen, ceiling mounted, 1800 × 1800 mm and stand, 1000 × 400 × 400 mm
B27AV	TOILET WC staff, female
B27BA	TOILET Personal washing
B27DW	TOILET Shower, patient categories 1–3
B27DZ	TOILET WC bidet and handbasin
B27EJ	TOILET WC personal washing, patient categories 1–3
B27EW	TOILET WC wheelchair and personal washing
B31AR	PARKING Infusion stand, twin hook, mobile
B31BK	PARKING Suction unit, electric, mobile
B31BL	PARKING Examination, lamp, mobile
B42AC	INFORMATION DISPLAY Location index board and shelf, 600 × 900 mm
B43AA	GROOMING Mirror 600 × 300 mm wall mounted, with shelf under
B48AN	MAINTENANCE Engineering bench
B48AO	MAINTENANCE Worktop heavy duty, cupboards over and under, lockable
B52AA	CLEANSING Domestic services, sink unit
C01CA	CLOTHES STORAGE Locker, single 1800 × 300 × 530 mm
C01CF	CLOTHES STORAGE Locker, luggage twin 1800 × 450 × 500 mm
C01GA	CLOTHES STORAGE Locker, small, wall mounted, 300 × 300 × 300 mm
C03CB	STORAGE Hook, hat and coat, two
C03CC	STORAGE Hook, hat and coat, three
C03CD	STORAGE Hook, hat and coat, four
C03CE	STORAGE Hook, hat and coat, five
C03GI	STORAGE Clip, spring 32 mm diameter
C04CA	CHAIR Upright, stacking
C04CB	CHAIR Upright with arm, stacking
C04CG	CHAIR Easy, with open arms, low back
C04CI	CHAIR Easy, unit
C04CL	CHAIR Easy, fully upholstered, low back
C04CN	CHAIR Upright, swivel with arms
C04EA	CHAIR Adjustable, 450–550 mm
C04GA	CHAIR Adjustable, 450–550 mm, mobile
C04GD	CHAIR Wheelchair, folding, attendant propelled
C04GF	CHAIR Sanitary chair
C04HB	CHAIR Anaesthetist, adjustable height, SS
C09CD	TABLE 710 × 900 × 600 mm
C09CF	TABLE 710 × 1200 × 600 mm
C09FA	TABLE Occasional, square 400 × 600 × 600 mm
C09FC	TABLE Occasional. 530 × 840 × 455 mm with shelf

'B' Sheet Code No	*Activity Unit Title*
C10CC	WORKTOP 600 mm wide, 1200 mm long
C10CG	WORKTOP 600 mm wide, 1600 mm long
C12DA	DISPOSAL CONTAINER Holder sack, small, foot operated, freestanding
C12DB	DISPOSAL CONTAINER Holder sack, medium, foot operated, freestanding
C12DC	DISPOSAL CONTAINER Holder sack, large, foot operated, freestanding
C12GA	DISPOSAL CONTAINER Bin, disposal, general purpose, 712 × 458 mm
C12GB	DISPOSAL CONTAINER Bin, disposal, general purpose, with liner, mobile
C12GC	DISPOSAL CONTAINER Bin, disposal, general purpose with lid
C13CA	BOOK STORAGE Bookcase, standing, 1200 mm long, open, 2 shelves
C13CC	BOOK STORAGE Bookcase, standing, 1200 mm long, open, 3 shelves, cupboard under
C13CF	BOOK STORAGE Bookcase, 1730 mm long, 3 shelves, glass doors, cupboard under, lockable
C17CA	MIRROR Wall mounted 1500 × 400 mm
C17CB	MIRROR Wall mounted 600 × 300 mm
C18CA	DISPLAY PANEL Wall mounted 800 × 600 mm
C18CB	DISPLAY PANEL Wall mounted 800 × 1200 mm
C18EA	DISPLAY PANEL Glazed 325 × 450 mm
C19CA	CHALKBOARD Wall mounted, 800 × 600 mm
C19CB	CHALKBOARD Wall mounted, 800 × 1200 mm
C20CA	MARKER BOARD Wall mounted, 800 × 600 mm
C20CB	MARKER BOARD Wall mounted, 800 × 1200 mm
C23CB	DOCUMENT STORAGE Cabinet, filing, 4 drawer
C23DC	DOCUMENT STORAGE Cabinet Card index 4 drawer
C23DH	DOCUMENT STORAGE Cabinet Card index 9 drawer
C23EB	DOCUMENT STORAGE Card index cabinet stand 450 × 450 × 450 mm
C27CB	STOOL Metal frame, 710 mm upholstered
C27CD	STOOL Kick, retractable castors
C27DD	STOOL Adjustable, 380 × 480 mm
C30AI	HAND TRUCK Film pack/chemical pack
C31CA	TROLLEY Storage, 5 tier
C31CE	TROLLEY Basket, 10 drawer
C31CH	TROLLEY Dressing/Instrument, SS, 750 × 450 mm, buffered
C31CJ	TROLLEY Instrument, SS, A/S castors, 870 × 1050 × 600 mm
C31FB	TROLLEY X-ray films, transport
C31GE	TROLLEY Soiled linen, single ring BS 2854
C31IH	TROLLEY Accident, X-ray top, with tilt and brakes
C31JB	TROLLEY Resuscitation, cardiac
C31KF	TROLLEY Cleaners
C31KI	TROLLEY Cylinder
C32DI	RACKING X-ray films, 1500 × 400 × 300 mm
C32DJ	RACKING X-ray films, vertical divisions, 1200 × 450 × 300 mm
C33CD	SHELVING Square ends, 600 × 500 mm
C33EB	SHELVING Square ends, 1200 × 300 mm
C33ED	SHELVING Square ends, 1200 × 500 mm
C33ER	SHELVING Sloping with square ends, 1200 × 300 mm
C33FB	SHELVING Square ends, 1500 × 300 mm
C33FD	SHELVING Square ends, 1500 × 500 mm
C33GC	SHELVING Square ends, 1800 × 400 mm
C33LC	SHELVING Slatted, wall mounted, adjustable, 1500 × 600 mm
C42ED	BED/COT/COUCH Exam/treatment, 800 mm high, cover dispenser
C42FC	BED/COT/COUCH Settee/bed, convertible, with arms
C52EA	DOMESTIC CLEANING Trolley, bucket, wringer

LIST OF ACTIVITY DATA 'B' SHEETS

'B' Sheet Code No	*Activity Unit Title*
C52EC	DOMESTIC CLEANING Dry suction machine, industrial cylinder
C52EG	DOMESTIC CLEANING Scrubbing, polishing machine, industrial

Appendix I

Radiological techniques

1. X-rays are generated in an X-ray tube by accelerating a focused beam of electrons emitted from a heated filament (the cathode) to impinge at high velocity on a target (the anode). The accelerating voltage between anode and cathode, which varies according to the techniques in use, is normally between 40 and 150 kilovolts. The X-rays are emitted from the small area of the target (the focal spot) which is bombarded by the electron beam. These rays have a high penetrating power and can pass through many substances including body tissues.

2. In their passage through the body, X-rays are partially attenuated, the extent depending on the nature and thickness of the tissues in the path of the beam. By placing a sensitive film (or other recording device) in the path of the emergent beam an image is formed of the body tissues in terms of their differing abilities to absorb the X-rays.

3. The rays which produce the film image emerge from the X-ray tube through a beam limiting device and are known as the useful beam. Additional radiation can also be present in the form of:

a. leakage from the X-ray tube housing;

b. scattered radiation, which is radiation generated by the interaction between the useful beam and objects in its path (including the patient) and is emitted in directions other than that of the useful beam;

c. residual radiation which having passed through both patient and cassette emerges in the direction of the useful beam.

Suitable measures must be taken in the building construction, and in the installation, siting, and use of X-ray equipment to ensure protection of all persons from unnecessary exposure to these forms of radiation.

4. The films used in radiography differ from those for most photographic processes in that they consist of a base coated on both sides with emulsion sensitive to light and to X-rays. When the X-rays irradiate a suitable material it fluoresces and, to enhance or 'intensify' the effect of the radiation, the sheet of X-ray film is held in close contact between two fluorescent surfaces known as intensifying screens, the emulsion thus being subjected to the influence of both light and X-rays. These intensifying screens are held with the film in a light-proof container known as a cassette, the largest of which (holding films of 35 cm × 43 cm size) may at present weigh up to approximately 2.8 kg. This method enables a diagnostic radiograph to be produced using a substantially reduced radiation emission compared with a 'non screen' technique. It lessens demands on the apparatus and reduces the radiation dose to the patient. Developments in intensifying screens technology (rare earth screens) have reduced even further the exposure required and thus the patient dosage. They also enable films with a lower silver content to be used, with consequent savings.

5. Other systems of recording X-ray images which do not use films or intensifying screens are under development and in limited use. These include xeroradiography and electron-radiography (ERG). In xeroradiography, a form of cassette—lighter in weight than conventional cassettes—is used as in general X-ray systems, but the image is produced by an electrostatic system and the resultant blue images are printed on paper rather than on film. The process is completely dry, no darkroom is required and the print being in paper form requires no viewing boxes. Where this process is to be employed, space will be required for the conditioner and the processor. ERG is a system under development in which the X-ray image is produced on a plastic sheet (not film) and, although having the appearance of an X-ray film, it does not require wet chemical processing.

Medical ultrasound techniques

6. Ultrasonics have an important part to play in diagnosis, eg in obstetric, urological, ophthalmic, cardiological and other examinations. Ultrasonic diagnosis is based on the passage of ultrasonic waves through a patient and for medical purposes, the frequency used normally lies between 1 and 20 MHz which is well in excess of the audible range. The energy is produced by a crystal, or series of crystals, of piezoelectric material actuated by a high frequency generator. Ultrasound is not transmitted through air and a coupling medium is required between the transducer (the probe) and the patient. The levels of ultrasonic power used in diagnostic applications are low and, as far as is known at present, are not harmful.

7. Ultrasound is capable of passing through biological tissue and other matter where, for example, bone attenuates severely whereas muscle does so to a lesser extent. The speed at which ultrasound travels is dependent on the density of the material. When applied to the surface of a part of the body the ultrasound waves will penetrate until an interface of different matter is reached when part of this energy is transmitted onward and part reflected.

8. By measuring the time delay between the transmitted pulse and reflected echo it is possible to display the depth of the interface on a cathode ray display. This is known as 'A' scanning. If, instead of keeping the probe stationary, the probe is scanned over the patient, a two dimensional picture may be built up which shows the location of organs

within the body. Two dimensional displays are known as 'B' scans. Multi-element and rotating transducers have opened up the field of 'real time' dynamic displays where, for instance, it is possible to display the movement of different sections of the heart.

9. Development of ultrasound apparatus is continuing rapidly and the requirements for services and accommodation will be subject to change.

Computerised imaging

10. Computer technology is used to form various images of the patient's anatomy. The resultant image is viewed on a TV monitor and may be recorded on photographic film, sheet paper, floppy disc, or magnetic tape. The accommodation, services and environmental requirements for this technique are different from those for conventional X-ray equipment.

Appendix II

Glossary

Actinic marking
The process of permanent identification of an X-ray film (with required details such as a patient's name, date of examination etc) by a photographic method using light or X-rays. The use of light is by far the more common method and various systems exist for marking a portion of the film either within the cassette or outside it. Systems that enable films to be marked before or immediately after exposure while within suitable cassettes, are widely used.

Angiography (Arteriography)—see Special procedures
A general term describing various X-ray investigations in which blood vessels are filled with radiographic contrast media to make them easily visible. Angiography can be performed on most parts of the body, eg cerebral angiography or renal angiography.

Anti-scatter grid
An assembly of evenly spaced lead strips, either parallel or focussed at a particular distance, mounted in a frame and positioned close to an X-ray film in order to reduce the amount of scattered radiation reaching the film during exposure.

Barium enema—see Appendix III.

Barium meal—see Appendix III.

Bucky (Potter bucky) diaphragm
A device whereby an anti-scatter grid (see anti-scatter grid) is caused to move or oscillate during the exposure. This allows the anti-scatter function to be performed without an image of the grid being visible on the film. The term is usually abbreviated to 'Bucky' and is used to refer not to the moving grid itself but to the assembly comprising a frame or holder containing the grid and having provision for the insertion of a cassette.

Capricode
Consists of Hospital Building Procedure Notes governing the planning and processing of individual health building development. It was substantially revised in 1974 and is at present out of print. It is intended to issue a new version redrafted to reflect the outcome of two recent reviews.

Cassettes
Light proof containers in which X-ray films are normally placed prior to exposure.

CAT or CT scanning
These initials stand for Computerised Axial Tomography and Computed Tomography respectively. This technique enables detailed examination to be made of body sections. The method uses a moving X-ray tube coupled to special detectors which measure the absorption values of the body section under examination. The results can be shown on a TV monitor.

CCTV
Closed Circuit Television which is used in conjunction with an image intensifier/amplifier to carry out fluoroscopy.

Chest stand
An apparatus, designed to hold cassettes in the vertical plane and normally floor standing with either ceiling or wall support, used for taking chest X-rays.

Cholangiography—See Appendix III.

Cholecystogram—See Appendix III.

Cineradiography (Cinefluorography)
The process of recording on film or tape the fluoroscopic image of organs in continuous movement, such as the heart.

Component Data Base (CDB)
A system developed jointly by DHSS and NHS of establishing standards of performance and design for components used in health building to support the guidance provided in Building Notes, Activity Data and Technical Memoranda. CDB includes 11 components which comprise the main elements of fitting-out, and are therefore of particular importance in the design and specification of accommodation. Wherever possible, CDB components are based on those available on the open market, but where the latter cannot meet health building requirements they have been specially developed.

More information can be obtained from CDB Office, Euston Tower, 286 Euston Road, London NW1 3DN.

Diagnostic index
An index of all examinations (or of selected examinations of interest) undertaken within a radiodiagnostic department, filed according to the diagnosis. The filing may be according to the International Index of Diagnosis or to some simplified local format. The index may be kept on cards or on computer.

Examination table or couch
The name given to the 'bed' on which many X-ray examinations are undertaken. They vary from simple fixed tables, those with fixed feet but with 'floating' tops which move freely in all horizontal axes, those which tilt in one direction only, to the very sophisticated which tilt 90° in each direction and have tops which have independent extensive movement both in longitudinal and lateral planes.

Fibre optic recorder
Recorders which are often used to provide permanent records of the examination of heart function by means of ultrasound. Light sensitive direct print paper is moved across the face plate of a cathode ray tube which incorporates a fibre optic bundle to transmit the light output from the phosphor directly on to the moving paper. The latent image recorded on the paper can be developed by exposure to a fluorescent tube.

Film changer
An apparatus, usually electro-mechanically operated, designed to allow a sequence of films to be taken at variable speeds, usually used in angiographic procedures. Whilst sometimes incorporated in an X-ray table, the apparatus is often separate. They can be used singly or in pairs and positioned in different planes known as bi-plane.

Film viewing box (also referred to as a film viewer or film illuminator)
An opal glass-fronted box evenly illuminated from the rear, on the face of which radiographs are clipped for viewing. Usually provided in multiples of 35 × 43 cm modules with switches or dimmers or both.

Fluoroscopy (Screening)
The use of X-rays to display images of internal structures or organs on a fluorescent screen. Such images are normally enhanced (by an image intensifier) for display on a TV monitor (TV screen) by CCTV.

HV Cables
High voltage cables convey the electrical energy from the transformer to the X-ray tube. Cables to the under-couch tube (where one is present) can be mainly carried in underfloor ducting; those serving the over-couch tube are suspended from ceiling mountings.

Intensifying screens
These are used singly or in pairs and consist of a fine layer of salts mounted on a thin card or plastic base. These salts fluoresce when excited by irradiation. The screens are fitted inside a light proof cassette and the X-ray film placed between them. Thus the effect of the radiation on the film is intensified, reducing the exposure required to achieve a diagnostic image.

Intravenous pyelogram — See Appendix III.

Ionising radiation
Ionising radiation is the part of the electromagnetic spectrum which is characterised by its property of ionising matter; examples are X-rays, gamma rays, electrons and protons, all of which have applications in medicine.

Lead equivalent (LE)
The lead equivalent of a material is the thickness of lead that would absorb radiation to the same extent as the actual thickness of the material concerned, under specified conditions of irradiation. Lead equivalent is expressed in mm and is used as a measure of the protective properties of shielding materials.

Lead glass (protective glass)
Glass which contains a high proportion of lead compounds and thus has a relatively high absorption of X-rays (ie a relatively high lead equivalent for a given thickness) although transparent to light.

Lead rubber
Rubber which contains a high proportion of lead compounds and is used as flexible protective material.

Lead rubber protective aprons
A protective apron worn (to protect the wearer against scattered radiation) when the operator needs to be outside the protective cubicle when an exposure is made.

Lead rubber protective gloves
Gloves made from lead rubber which protect the operator's hands from direct X-rays.

Light beam diaphragm
A device used to illuminate the desired area of the patient for accurate positioning prior to radiography. The device incorporates a set of lead 'leaves' which ensure that during radiography X-rays are confined to the illuminated area.

Mammography
Mammography is the radiographic examination of the breast; special X-ray apparatus and film are used.

Master index
An index containing data referring to all patients examined within a radiodiagnostic department. The data includes such details as the patients name, address, age, sex and hospital number; it may in some instances be combined with the report index. The index may be kept on cards or increasingly on computer.

Multi film viewer
An apparatus comprising a number of movable electrically or mechanically operated panels which are capable of being placed in front of a fixed viewing box (commonly of light modules) so that multiple radiographs may be viewed sequentially.

Nuclear magnetic resonance (NMR)
Images of anatomical structures which may be obtained by computing suitable signals which are obtained when a patient is placed in a strong magnetic field. The procedure is still at an early stage of development but it is attractive because it does not involve the use of X-rays.

Programme selector
A control unit separate from the main X-ray console which is used with rapid film changers to pre-select exposure programmes.

Radioactive isotope
In the context of radiology the term is used to indicate a chemical substance artificially made radioactive with a relatively rapid rate of decay and suitable for administration to a patient (usually by injection). The substances used are emitters of gamma radiation and enable a survey of the organs in which they are absorbed to be made by detection of the emitted radiation in a linear scanner or gamma camera. Different substances are used according to the organ(s) under investigation.

Remote control fluoroscopic apparatus
This term applies to a type of fluoroscopic apparatus which can be completely operated by the radiologist from a remote console behind the protective screen.

Report index
An index containing details of the examination request and radiologist's report; it may, in some instances, be combined with the master index. The index may be kept on cards or on computer.

Safe-lit area
A safe-lit area is one from which natural and artificial light can be excluded by use of light-proof doors or partitions and which has photographically 'safe' lights installed for use when required. This enables the area to be used for handling photographically sensitive materials in safe conditions when necessary, eg loading/unloading of film magazines.

Scatter (scattered radiation)
Radiation which has been deflected from its original path and is a hazard both to film quality and to personnel.

Skull table
A type of X-ray apparatus which is designed specifically for cranial examination including cerebral angiography. In some cases a tomographic facility is also included.

Special procedures—see angiography
A composite term used to distinguish radiological examinations of more complexity (eg arteriography) from the more common investigations.

Ten day rule
To reduce the likelihood of irradiation of a possibly unknown pregnancy, examinations involving the lower abdomen of all women of reproductive capacity should, whenever possible, be carried out within the first 10 days of the menstrual cycle. The application of this principle is known as the "10 Day Rule".

Thermography
The recording, for diagnostic purposes, of the variation in the amount of heat being emitted by infra red radiation from different structures or parts of the body. A cathode ray tube (CRT) is commonly used for the display.

Tomography
A radiographic technique designed to form a diagnostic image of a selected plane within the body. In conventional tomography (as opposed to CT scanning) the method used is to move the X-ray tube and the film in opposite directions during the exposure in such a manner that the desired plane is imaged sharply, but other planes are blurred. The movement is commonly linear, but more complex movements in two dimensions are also often employed.

Trendelenburg
A term used to indicate the head down or adverse tilt of an X-ray tilting table. Such tables normally move from a vertical position through the horizontal to a varying degree of adverse tilt. The range of movement of an individual table is often shown for example as 90°/30° which would indicate a vertical position in one direction and an adverse tilt or trendelenburg of 30°.

Ultrasound—See Appendix I, paragraph 6.

Videostore (memory device)
A device incorporated in a CCTV system to memorise a stationary image during fluoroscopy. This can reduce the switched on time of the X-rays and the exposure of the patient and staff. It is sometimes used in a single flash mode to replace radiography and to reduce the delay due to film processing eg in operating theatres.

Appendix III

Description of some common contrast media X-ray investigations

1. Radiological investigations can be divided into two main categories: those for which no dieting or other preparation is required, and those in which a combination of such preparation and administration of a contrast medium are involved.

2. Contrast media are substances which are both suitable to administer and differentially absorb radiation, thus enabling the organ or system in which they are situated to be outlined. This technique is required when the part of the body under investigation has a similar density to its surrounding tissues and is not, therefore, readily visible on a plain radiograph.

3. Two of the commonest contrast materials in current use are barium (barium sulphate) and organic iodine compounds. Brief details of some investigations using these media are given.

Barium enema—An examination of rectum and large bowel.

4. Following colonic lavage or an evacuation preparation, the bowel is filled with barium via a rectal catheter. The radiologist will monitor progress on the TV monitor and take films as required. This part of the examination takes 5–10 minutes and may be followed by injection of air to enable 'double contrast' studies to be made. The patient will then go to the WC to evacuate the barium after which further films may be taken of the 'empty' rectum and bowel. The patient may need to rest in the recovery room before this phase of the examination. The whole procedure usually lasts approximately 30 minutes, but may be longer in some cases.

Barium meal—An X-ray examination of the upper digestive system.

5. Patients initially stand (whenever possible) between the vertical X-ray couch and the image intensifier. They then swallow the barium under the direction of a radiologist who watches the process of the barium into the stomach and digestive tract on the TV screen. In addition to the TV image, the radiologist can also take 'still' X-ray films when he wishes to record a particular stage in the investigation. The patient may be examined lying down as well as standing, and may be repositioned at intervals to help the radiologist obtain the best view of the suspected pathology. The procedure usually takes between 15–30 minutes, although when progress through the lower part of the digestive system is also undertaken, a series of films may be required at intervals throughout the day and even 24 hours later.

Intravenous pyelogram IVP (also commonly termed Intravenous Urogram IVU)—an examination of the urinary tract.

6. After a preliminary film has been taken, a contrast medium is injected (usually into the patient's arm) and this enables the kidneys, ureters and bladder to be visualised on X-ray films. The examination involves a series of films being taken by a radiographer at timed intervals. Tomography (Appendix II) is often involved in this procedure. The total examination normally takes about an hour but can vary considerably from patient to patient.

IV Cholangiography—An intravenous cholangiogram is an examination of the biliary system.

7. This procedure is similar to an IV pyelogram in that a preliminary film is followed by a contrast medium injection or infusion. A series of timed films is taken by a radiographer, again often involving tomography. The examination can take as long as 3 hours.

Cholecystogram—An X-ray examination of the gall bladder.

8. The patient is given a dose of contrast medium to swallow 12 hours prior to the X-ray. The examination is undertaken by a radiographer who will take a series of films from a variety of positions to try to show the full gall bladder clear of surrounding organs and in different planes. Once this part of the examination is complete, the patient swallows a fatty preparation which causes the gall bladder to contract and eject the contrast material into the bile ducts. After an interval for the preparation to take effect, a further series of films is then taken. The examination can last for $1\frac{1}{2}$ hours.

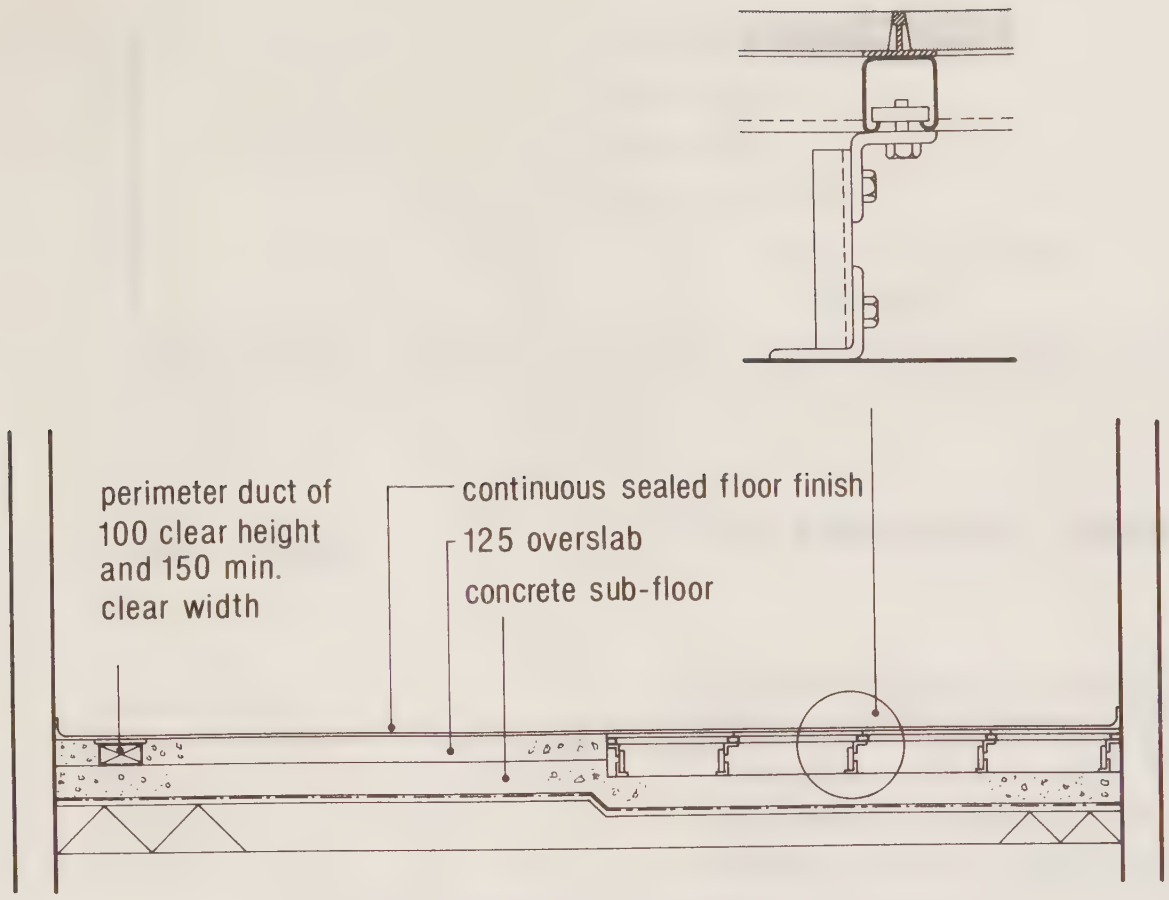
Appendix IV

Radiodiagnostic room floors

1. In the provision of floors for radiodiagnostic rooms experience has shown that traditional construction consisting of a concrete slab or sub-floor with a screed of normal thickness fails to provide the required flexibility when installing interconnecting cables between items of equipment. This failure is most apparent when equipment is renewed, which can happen a number of times during the life span of a radiodiagnostic department. The resulting disruption to the smooth running of a department when a floor has to be disturbed is well known.

2. There are a number of alternative methods which may be employed in the construction of floors in radiodiagnostic rooms to increase flexibility and reduce disruption. The choice of a particular option should be carefully considered, bearing in mind the particular requirements of the project and the cost involved. (6.13) One factor which should be borne in mind when choosing options 2 or 3 is that a greater depth is required for the floor construction. If as recommended (2.17) the radiodiagnostic department is on the ground floor this will not cause complications. If, however, the department has to be located on an upper floor this can only be achieved at the expense of restricted storey height to the accommodation below.

3. The options which follow are listed in order of cost with the most economical given first. The options are expressed in general terms; more detailed information is set out in the flooring document of the Component Data Base. (Appendix II)



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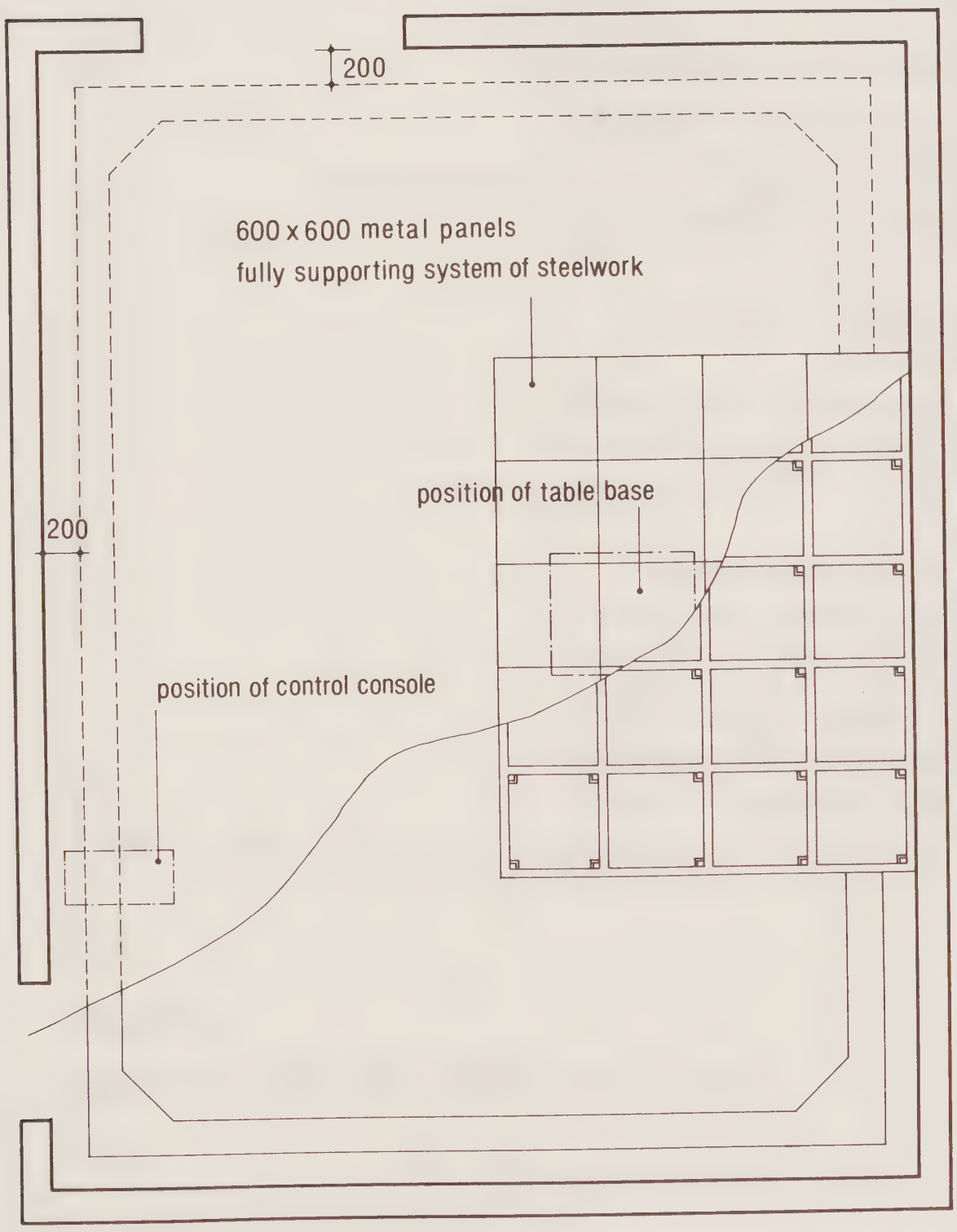


PLAN

FIGURE 1

Option 1 : Floor with increased thickness of screed (Overslab) and limited area of loadbearing modular access

Option 1

Floors with increased thickness of screed (overslab)

1. This option (6.11) incorporates an increased depth of floor screed with a perimeter ring cable duct from which connections may be made to the generator, equipment racks and control console, etc. In addition, there is a section of load-bearing modular access floor over the area in which it is anticipated that the X-ray table will be sited: a degree of flexibility is thus provided.

2. In the event of equipment being enhanced or renewed, additional cable trunking risers may be teed into the perimeter duct.

3. The perimeter ring duct needs to have a clear internal height of 100 mm and would normally be constructed of galvanised steel with a suitable flush removable lid. The floor finish should be continuous and sealed, but have a welded inset to delineate the position of the floor duct and access points.

4. This type of floor would, therefore, consist of:

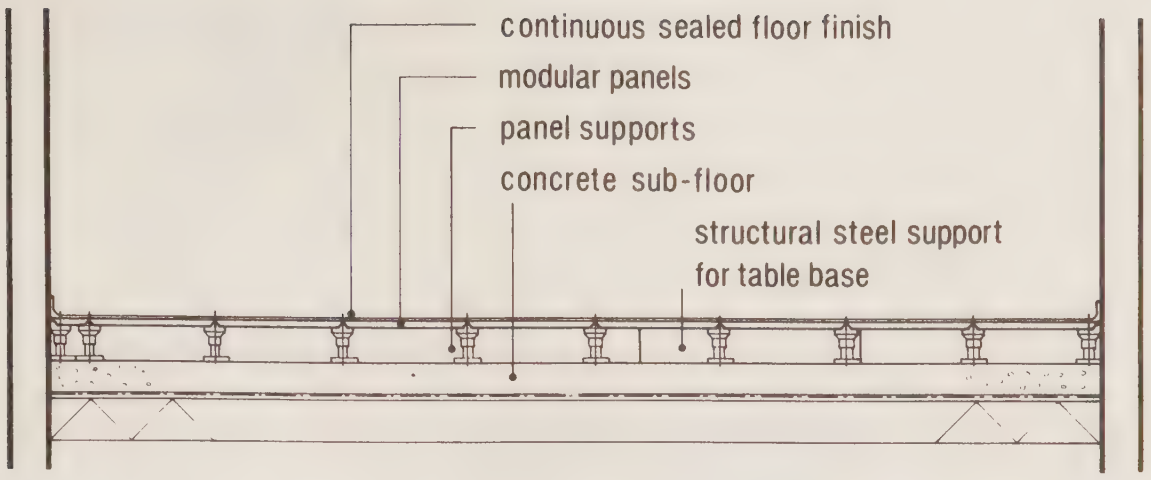
   a. A continuous sealed floor finish;

   b. A minimum of 125 mm overslab of fine concrete (overslab is the term used by the Cement and Concrete Association for screeds in excess of 75 mm);

   c. A separating membrane;

   d. A structural floor slab or a concrete sub-floor.

5. The drying-out period for overslabs of this nature is significant and may well be in the region of 25 weeks. Account of this should thus be taken at an early stage in the construction programme. However, certain types of over-slabs laid by specialist contractors offer substantially reduced drying-out periods (see Component Data Base).



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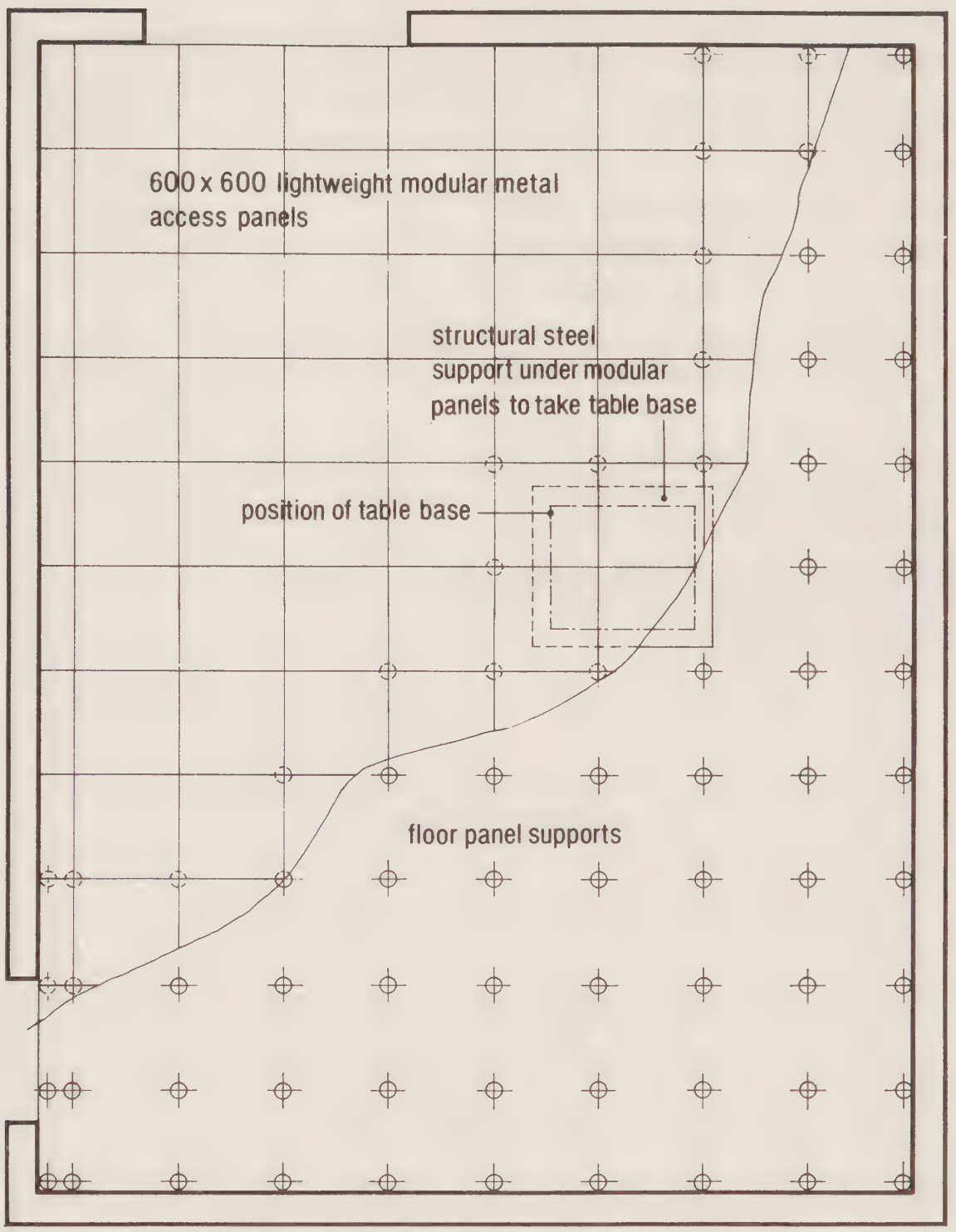


PLAN

FIGURE 2

Option 2: Lightweight Modular Access Floor

Option 2

Lightweight modular access floor

1. This option (6.15f) allows for a hollow floor which in principle offers complete flexibility for cable runs between radiodiagnostic equipment and is similar in concept to a floor associated with a computer installation. (Figure 2)

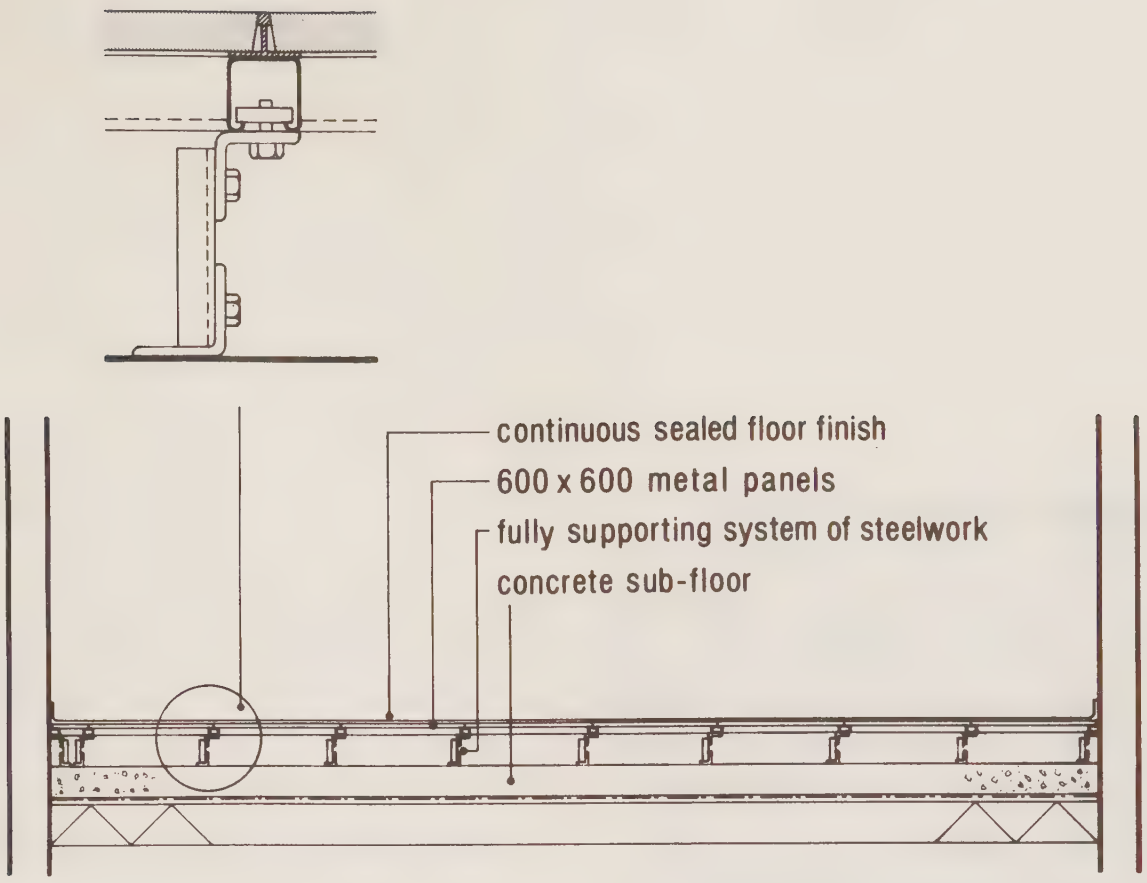
2. This type of floor would, therefore, consist of:

   a. A continuous sealed floor finish;

   b. A proprietary or similar modular access floor with a recommended clear depth of 200 mm formed with standard floor panels, normally 600 mm square, on adjustable screw-jack supports;

   c. A structural floor slab or a concrete sub-floor with power-floated finish.

3. Attention must be given to the detailing of concrete or steel supports to carry the loads of main items of radio-diagnostic equipment, particularly the table. This will require a base plate necessitating the trimming of floor panels around it. It is particularly important to consider the movement of equipment during installation.



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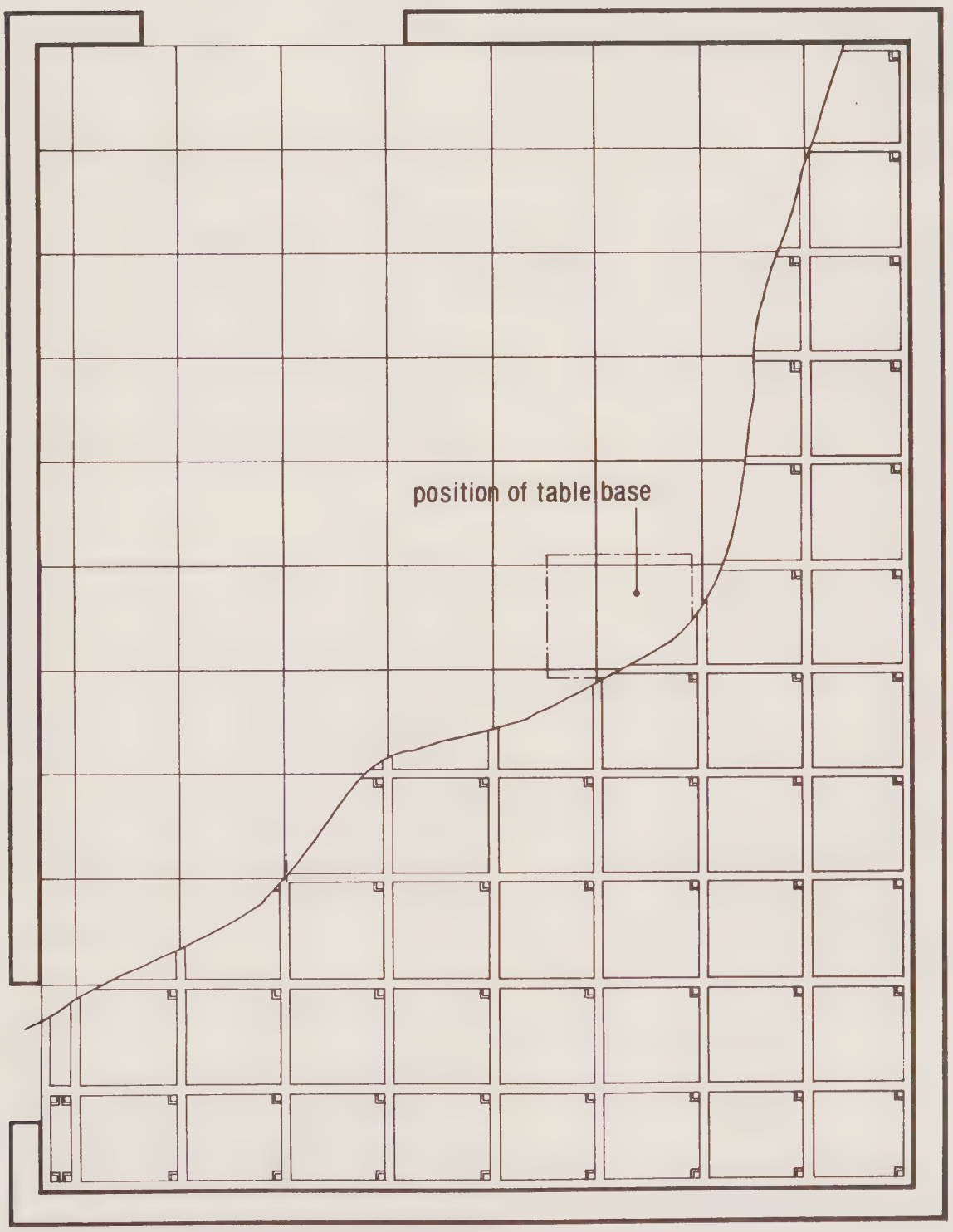


PLAN

FIGURE 3

Option 3: Loadbearing Modular Access Floor

Option 3

Loadbearing modular access floor

1. This option (6.15g) offers the same facility of flexibility for cable runs as in Option 2, and, in addition, due to its strength, allows for the weight of radiodiagnostic equipment without additional supports. (Figure 3) This type of floor would, therefore, consist of:

   a. A continuous sealed floor finish;

   b. A floor sheathing, with structural metal panels;

   c. Metal framework;

   d. A series of supports;

   e. A structural slab or a concrete sub-floor with power-floated finish.

2. This option is expensive.

Appendix V

Statistical data

The information contained in this Appendix should assist the project teams in calculating future needs for radiology in their District. It is important that it should be read in conjunction with paragraphs 2.12 to 2.15 of this Note.

1. *Values derived from research studies and surveys*

1.1 *Time per examination* The average time taken to perform a single radiological examination has been variously calculated to be from 10–13 minutes. Departments undertaking a high proportion of simple procedures will have an average time per examination towards the lower end of this range and vice versa.

1.2 *Room utilisation* The percentage of working time during which a radiodiagnostic room can be in active use will vary according to the nature of the work being done. Authorities should plan from the outset to achieve the maximum utilization of rooms. With this in mind it should be noted that a greater throughput may be obtained by centralising facilities which also provides economy of building, staffing and equipment, while dispersed facilities are more likely to be under-used. An average occupancy factor of between 0.55 to 0.70 (ie 55% to 70%) should be achievable.

1.3 *Planned examinations per room per year* The number of investigations which can be performed in a diagnostic room varies considerably. At one end of the range, rooms dedicated to interventional procedures, which in some cases last several hours, may be used for less than 1000 examinations in a year. At the other end of the range are rooms used for very short term procedures such as chest X-rays where as many as perhaps 12000 examinations could be carried out. In practice many departments deal with anything between 5000 and 8000 examinations per room per year.

2. *Number of examinations anticipated per year per 1000 of the catchment population*

To determine the number of examinations anticipated per year per 1000 of the catchment population, it will be necessary for the project team to consider the spectrum of anticipated procedures to be undertaken together with the proposed work pattern and other radiodiagnostic services both existing and projected within the catchment area. Reference to past records and the existing work load may also be made. Project teams should consult their professional advisers and obtain advice from the District statistician on the probable catchment population.

3. *Formula for calculation of number of radiodiagnostic rooms required*

3.1 Project teams may wish to try out different sets of figures in the formula and test them in the light of their own circumstances, noting that small changes in the input figures may make large changes to the resultant number of rooms. The figures should be based upon good practice in a well-designed building using modern equipment, and thus may well show an improvement upon the throughput of an existing service, especially if the latter is not concentrated in one hospital.

3.2 To calculate the number of radiodiagnostic rooms likely to be needed, the considerations described in paragraphs 2.12 to 2.15 of the main text of the Note should be taken into account and the following formula used:—

$$N = \frac{X \times (E - O)}{R}$$

Where N = Number of radiodiagnostic rooms
X = anticipated number (in thousands) of people in the catchment population to be served
E = number of examinations anticipated per year per thousand of the catchment population to be served
R = planned average number of examinations to be carried out per year per radiodiagnostic room
O = number of examinations done outside normal working hours.

Calculate R as follows:

$$R = \frac{T \times U}{M}$$

Where T = working time available per year in minutes
U = average room utilisation rate (para 1.2 of Appendix)
M = average time per examination in minutes (para 1.1 of Appendix)

3.3 *Worked example*

$$N = \frac{X \times (E - O)}{R}$$

Step 1 Determine from local statistics the anticipated number of people in the catchment population, ie if population is 190,000

$\therefore$ X = 190

Step 2 Determine from local statistics the number of examinations/year/thousand, catchment population

Say E = 450

Step 3 Subtract the percentage of work undertaken outside normal hours, say 20%

20% of 450 = 90
∴ O = 90
∴ E−O. = 450−90
= 360

Step 4 Calculate R as in paragraph 3.2

$$R = \frac{T \times U}{M}$$

Say T = 120,000 (= 250 days × 8 hours × 60 mins)
U = 0.7 (= 70% utilization)
M = 12 (minutes)
∴ R = 7000

Step 5

$$N = \frac{X \times (E-O)}{R}$$

$$N = \frac{190 \times 360}{7000}$$

$$= 9.77$$

Say 10 rooms in this particular example.

References

i. 'Towards a Clearer View', Nuffield Provincial Hospital Trust, OUP, London, 1962.

ii. 'Organisation and Design of Radiodiagnostic Departments', Western Regional Hospital Board, Scotland, January 1973.

iii. Health Equipment Note 6. Radiognostic Department, DHSS, 1982.

Appendix VI

Basic equipment

1. The functions and physical characteristics of the individual items of equipment listed in paragraph 4.33 are summarised below.

2. *The high voltage transformer (generator) unit* is designed to generate the high voltage electrical energy required to produce the radiation from the X-ray tube. A high voltage generator may be chosen which can be controlled by more than one console each equipped with all the selectors, displays and exposure controls necessary for making an exposure. These consoles may be geographically separated and each may control a complete radiographic equipment assembly, incorporating one or more X-ray tubes.

3. *The control console* has the full range of controls and facilities necessary to provide the radiological exposure factors for the equipment with which it is associated. Control consoles vary considerably both in size and weight. Modern design tends to reduce the overall dimension and weight of the control console by housing the more bulky elements in separate electronic equipment racks which are normally sited within radiodiagnostic rooms. Where one high voltage generator with its associated equipment racks is shared between radiodiagnostic assemblies in different rooms, each control console must have the full range of controls.

4. *Specialised equipment racks* are used to:

   a. accommodate the more bulky and complex control circuitry and allied parts of the high-voltage generating system which require easy access for maintenance.

   b. accommodate the control circuitry and allied components of accessory equipment, eg CCTV (Appendix II) or camera systems.

5. *X-ray tube supports* can be floor-to-ceiling or ceiling-suspended, with tracks as appropriate. The type chosen will depend on the radiological application. Care should be taken to ensure that the range of all the movements of the tube is sufficient for the techniques envisaged. The tube mounting must permit the X-ray tube to rotate about its long and short axes and around the vertical column. The facility to lock the X-ray tube rigidly in any selected angle at a pre-selected film focus distance is essential. The types of tube supports are:

   a. a floor/ceiling column which may be either static or movable on floor and ceiling track(s); it comprises a vertical column with a counterpoised cross-arm for the carriage of the X-ray tube and mounting.

   b. a ceiling-mounted tube support which comprises a vertical tube column of either telescopic or articulated sections mounted on a carriage assembly; the latter runs on ceiling tracks longitudinally, laterally or both.

6. *The X-ray tube* comprises an 'insert' (an evacuated glass envelope containing the electrodes—anode and cathode) fitted within an oil-filled cylindrical metal housing or 'shield'. The housing is lined with lead to reduce the emergence of unwanted X-radiation but has a port or 'window' through which the useful X-ray beam emerges.

7. *Other examination equipment.* In addition to the basic X-ray generating equipment, individual rooms may be fitted with a range of purpose-designed examination tables, stands or ancillary apparatus, which may also incorporate a dedicated X-ray tube. Computers will on occasion form an integral part of radiological equipment.

Note: Project teams are advised to consult manufacturers about the total heat emitted from all the diagnostic equipment assembled in each diagnostic room. In special procedures rooms the number of persons involved in an examination will also influence the heat gain.

Appendix VII

Silver recovery

1. The 'screen' type medical film, which currently comprises approximately 90% of the X-ray film used in the NHS, contains on average approximately 7.5 grams of silver per square metre of film in its photo-sensitive emulsion. 40% to 50% of this silver is removed from the film in processing and is left in solution in the fixing bath; most of it can be recovered from the solution by treatment of the used fixer in the hospital. Recovery of the proportion of silver left on the film is achieved by selling discarded films for commercial treatment outside the hospital.

2. The operation of an efficient system of silver recovery is important for the following reasons:

a. silver recovery is a significant source of revenue to the NHS;

b. silver is a scarce natural resource requiring conservation;

c. silver is toxic to certain micro-organisms and the discharge of solutions with a high silver content into drains is not allowed since its presence in sewage sludge makes water purification difficult;

d. in certain circumstances re-use of fixer is made feasible, thus reducing expenditure on new fixer.

3. Either the metallic replacement method or high current-density electrolysis is normally used in the NHS for the recovery of silver from used fixer. The trend has been towards the use of high current-density electrolysis as suitable equipment has become more readily available. The low current-density electrolytic method, which in practice is limited to use with manual film processing, is not detailed in this Appendix as it has been virtually displaced by high current-density electrolysis.

4. In the metallic replacement method the used fixer solution (containing 2 to 6 grams of silver per litre) is metered from the film processor through a vessel (typically of 20 litres capacity) containing layers of steel wool pads. By contact with the extensive surface of the steel wool, a chemical change takes place between silver and iron in which the iron is consumed and silver compounds are deposited as part of a solid residue in the vessel. This residue is periodically removed (often by exchange of the vessel) by a contractor who allows credit according to the silver content found on assay. The liquid residue from this process, although depleted of silver, is otherwise heavily contaminated and is discharged to waste.

5. The metallic replacement method is essentially inexpensive and simple to install, and requires no electrical supply, but there is a significant running cost from the need to replace the steel wool pads. The value of the silver in the solid residue is reduced by relatively high refining and assay charges because the silver is in a highly impure form. Re-use of the fixer is not feasible with this method.

6. In the high current-density electrolytic method, an electric current is passed through the silver-laden fixer between immersed electrodes (anode and cathode). Agitation of the electrolyte and movement of the cathode are used to enable the required high current-density to be maintained. The silver is deposited as a high-purity metallic flake on the cathode and is periodically removed. The electrolysed solution (which may contain as little as 0.1 gram of silver per litre) is not contaminated by the process, and there are systems in which the solution is recirculated to the (automatic) film processor, thus reducing the consumption of new fixer by up to 50 per cent. The cost of an installation is high in comparison with the metallic replacement method and electricity is consumed. However, there are no other consumables and the high-purity flake has a higher realisable value per gram of silver than that of the impure residue from the metallic replacement process.

7. In the interest of health and safety silver recovery units should be located so that staff are not exposed to obnoxious fumes; units should not be placed in dark rooms, but in well ventilated areas.

8. There must be provision for the safe custody of recovered silver.

9. In some cases where suitable commercial services are available it may be possible to arrange for the collection and purchase of used fixer solution in bulk. The re-use of fixer is of course not compatible with this procedure.

Appendix VIII

Critical dimensions

Introduction

1. Critical dimensions are those dimensions which are critical to the efficient functioning of an activity; thus the size of components, their position and the space around them may all be critical to the task being performed. Guidance on these dimensions for a particular activity is provided in the form of *component—user data sheets.* These illustrate components, ie equipment, furniture and fittings, and provide ergonomic data on the space required for users to move, operate or otherwise use the component; information about the component, eg fixing heights, and the users, eg reach, is also provided. Component-user data sheets thus complement the information given on Activity Data 'B' sheets (see Chapter 4).

2. This appendix contains sheets relevant to this Note. In addition, ergonomic data common to the design of a number of departments is contained in the *Common Activity Spaces* Health Building Note, to which reference should also be made.

Component dimensions

3. These relate to the size and position of components as follows:

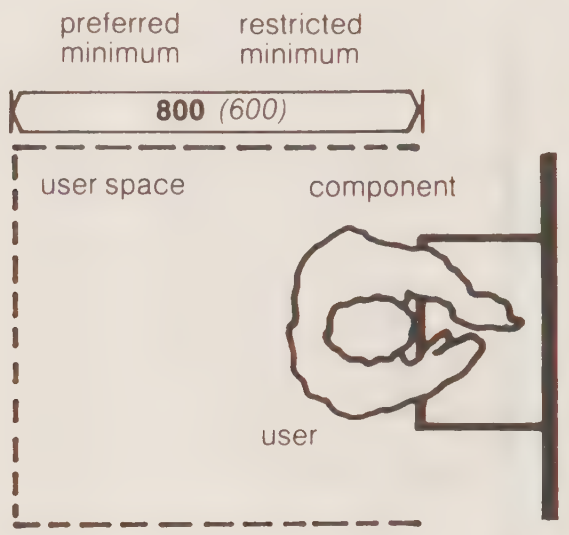
a. Sizes of components are shown thus

b. Preferred component fixing heights are shown as heights above floor level thus

(In some cases an acceptable range of fixing heights is also given in italics.)

Activity dimensions

4. Activity dimensions define the user space, which is the minimum space required to perform an activity. Two types of activity dimension are given:

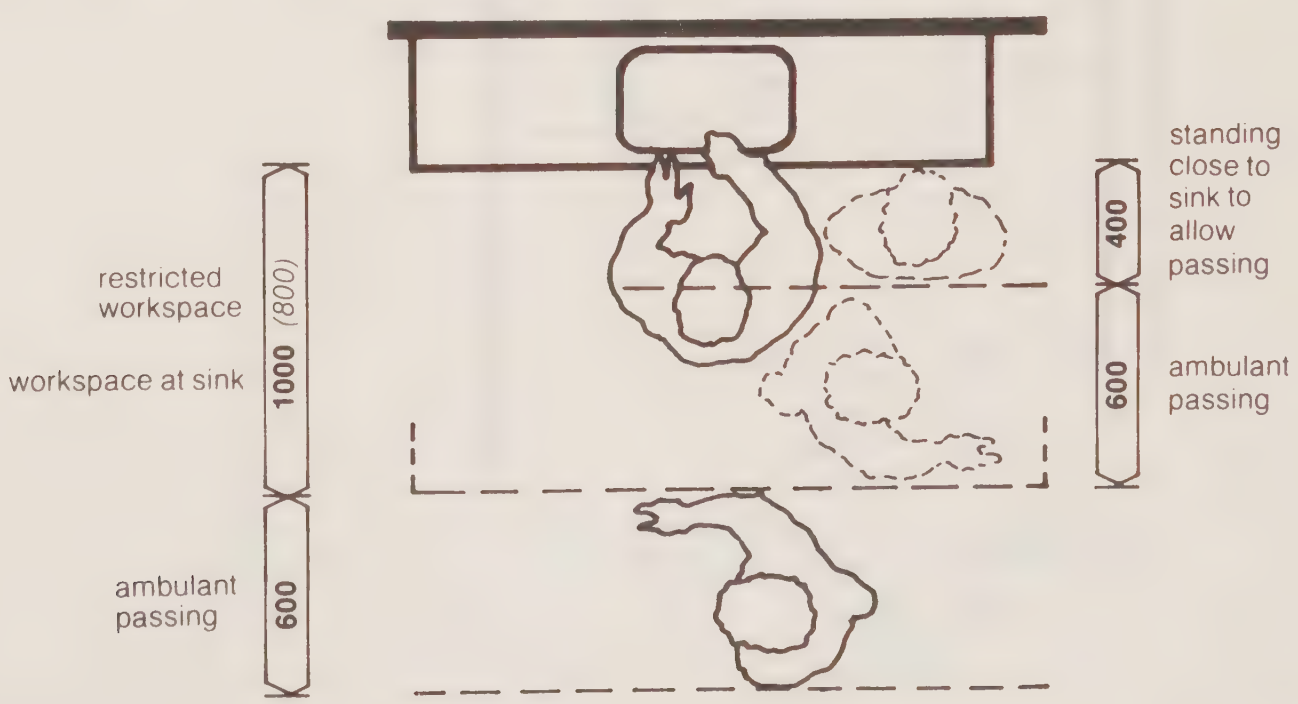


a. Preferred minimum—This defines the minimum space required to carry out an activity efficiently and is shown in bold type.

b. Restricted minimum—This will only allow the activity to be performed at the expense of the user experiencing some difficulty. It is not recommended for general application but may be appropriate when considering the overlapping that can be allowed when two user spaces are adjoining.

Selection of activity dimensions

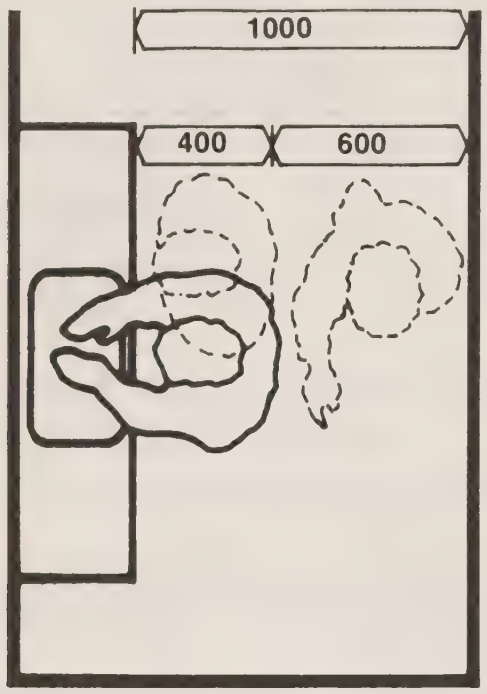
5. When using component-user data sheets to design activity space layouts, selection of the appropriate activity dimensions is essential for economy and efficiency. Selection should be based on careful consideration of the frequency, duration, timing and importance of the activities and also the number of people involved. A typical example of the use of a sink showing activity dimensions provided by the component user data sheet is shown below.



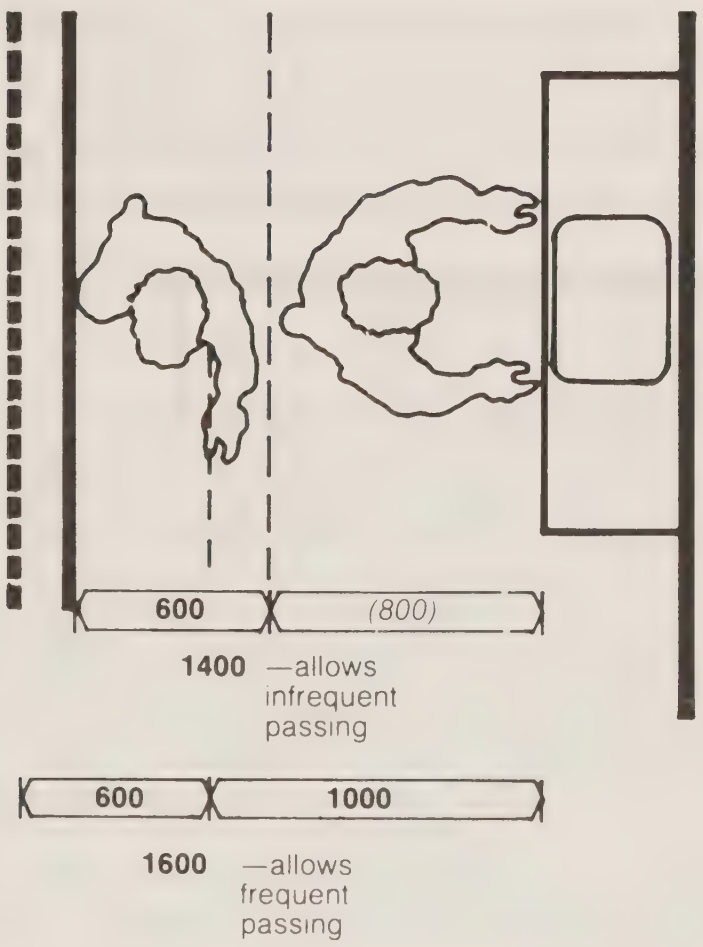
Examples

6. The following worked examples show the sink being used in 3 different situations and show how the appropriate dimensions would be selected. These examples have been simplified and additional factors such as the movement of mobile equipment may also be critical.

a. If the room is normally occupied by one person only the 1000 workspace dimension may be applicable. An (800) restricted dimension should not be used as this dimension is only applicable where two user spaces are adjoining, not where an individual user space is bounded by a wall or solid obstruction. If the person using the sink stops work and stands close to the sink, 1000 is also sufficient space to allow a second person to pass, ie 600 + 400.

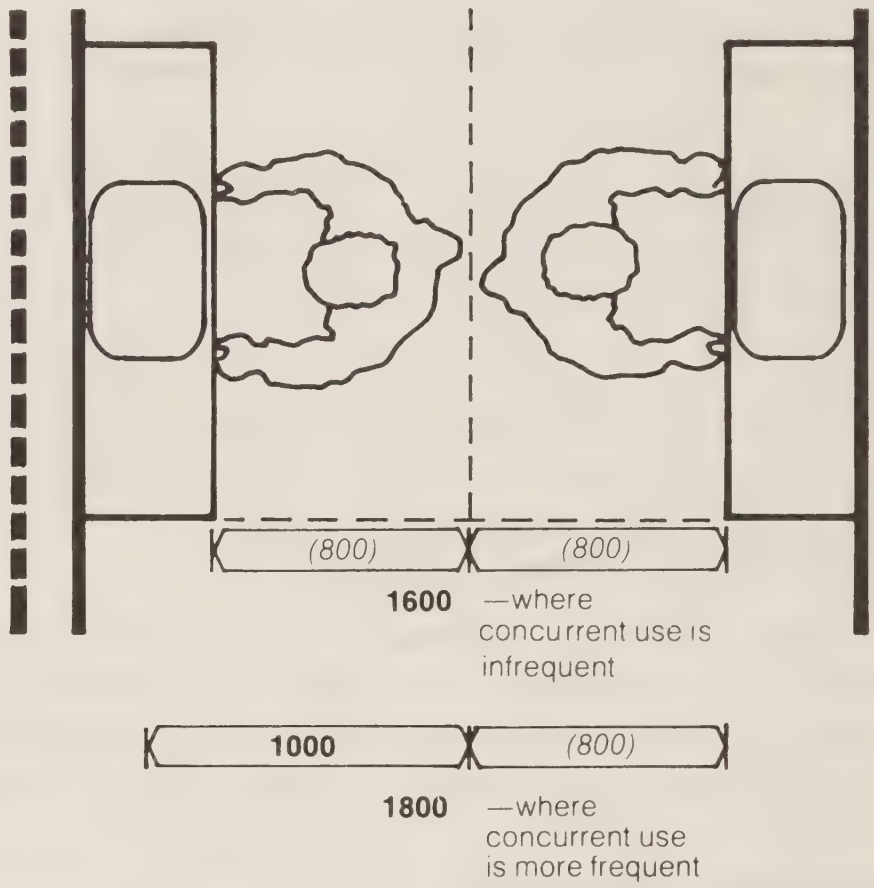


b. If space is required to allow a person to pass, without the user of the sink stopping work, then the 600 passing dimension is added to the workspace dimension. If passing is infrequent then temporary restriction of the sink user's space may be acceptable; this gives an overall dimension of 600 + (800) = 1400. If passing is frequent and restriction of the sink user's space is not acceptable the overall dimension is 600 + 1000 = 1600.



c. Where space has to be provided to enable two sinks to be used concurrently the overall dimension between sinks will be the sum of the workspace dimensions, eg if concurrent use is infrequent and of short duration then (800) + (800) = 1600 may be acceptable. Alternatively 1000 + (800) = 1800 allows the full workspace for one sink user and restricted space for the second user, where concurrent use of the sinks is more frequent.

Note: The passing of a third person passing between the two sink users may also be critical in this example. Where the sinks are staggered 1400 may be acceptable as in example b.



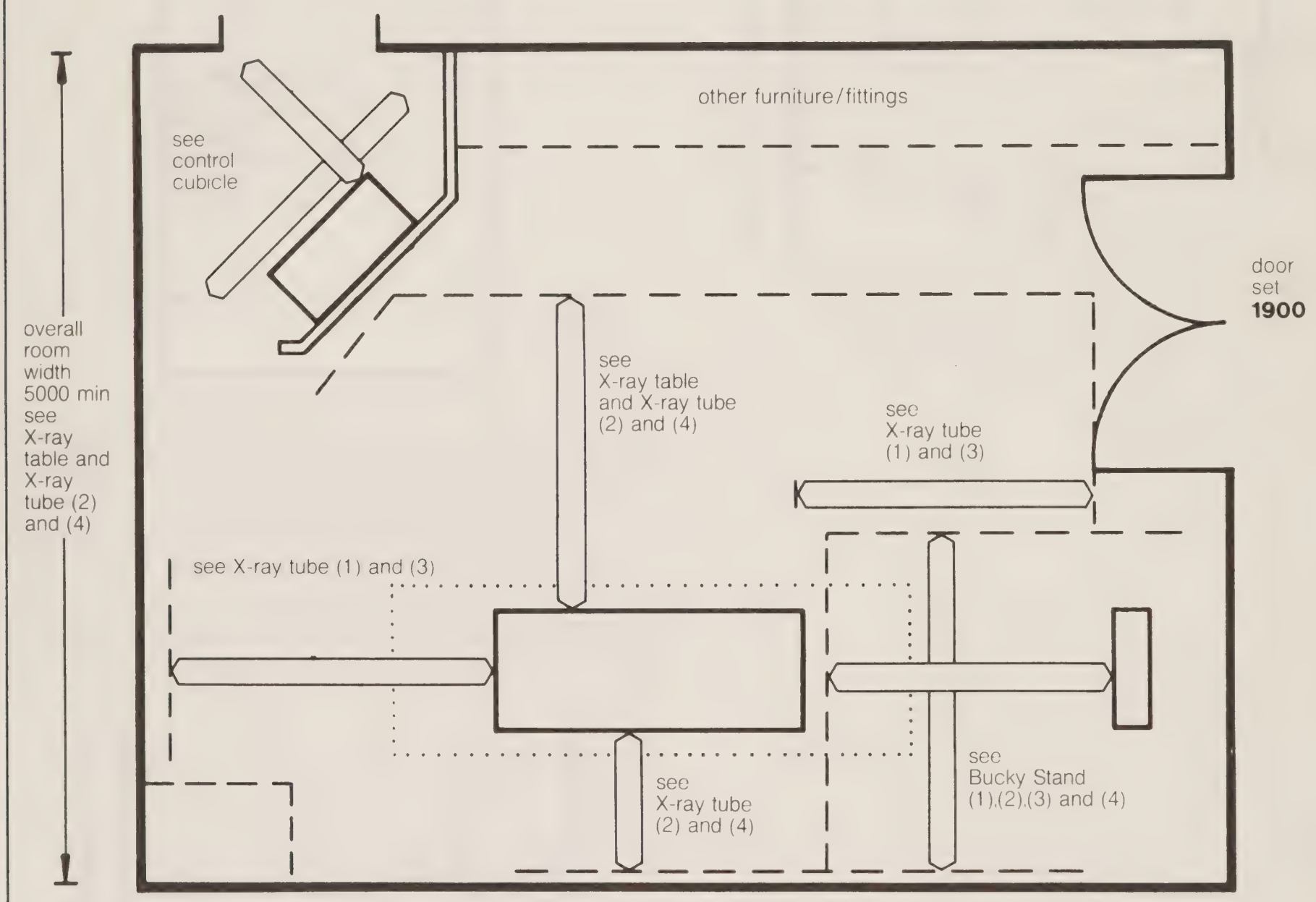
List of ergonomic drawings

1. Key diagram
2. Control cubicle
3. X-ray table
4. X-ray tube (1)
5. X-ray tube (2)
6. X-ray tube (3)
7. X-ray tube (4)
8. Bucky stand (1)
9. Bucky stand (2)
10. X-ray illuminators
11. X-ray worktop

DHSS **Ergonomic data bank:**
Activity space data sheet, not to scale

Key Diagram

X-ray HBN


other furniture/fittings
see control cubicle
door set **1900**
overall room width 5000 min see X-ray table and X-ray tube (2) and (4)
see X-ray table and X-ray tube (2) and (4)
see X-ray tube (1) and (3)
see X-ray tube (1) and (3)
see X-ray tube (2) and (4)
see Bucky Stand (1),(2),(3) and (4)

Notes:

The ergonomic data sheets on X-ray equipment relate specifically to general purpose radiodiagnostic rooms and include X-ray tables, bucky stands and control console. In the layout of general purpose radiodiagnostic rooms the space requirements around these items of equipment are particularly critical. However consideration should also be given to other fittings and equipment such as worktop/storage units, washing facilities, small trolleys, protective apron racks, chairs and specialised or electronic equipment racks etc. Inclusion of any additional items of X-ray equipment (eg small dental unit) may also affect overall space requirements.

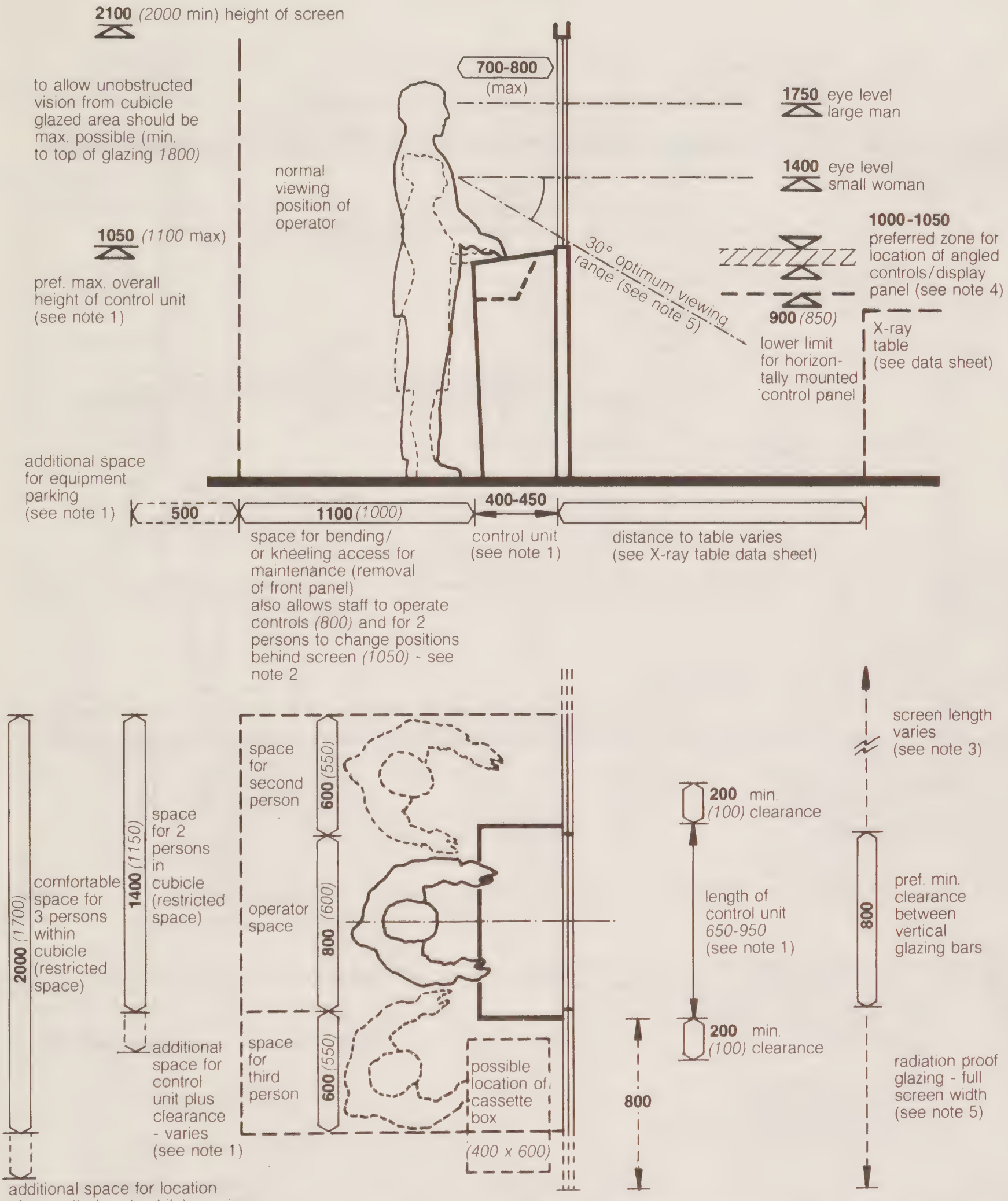
The schematic drawing above is intended to show a likely relationship between these main items of equipment within a general purpose radiodiagnostic room.

Activities:
Control of exposure factors during general radiodiagnostic procedures behind radiation proof screen.

DHSS **Ergonomic data bank:**
Component-user data sheet, not to scale

Control cubicle

Users
Radiographer


2100 (2000 min) height of screen
to allow unobstructed vision from cubicle glazed area should be max. possible (min. to top of glazing 1800)
700-800 (max)
1750 eye level large man
1400 eye level small woman
normal viewing position of operator
1050 (1100 max)
pref. max. overall height of control unit (see note 1)
30° optimum viewing range (see note 5)
1000-1050 preferred zone for location of angled controls/display panel (see note 4)
900 (850)
lower limit for horizontally mounted control panel
X-ray table (see data sheet)
additional space for equipment parking (see note 1)
500
1100 (1000)
space for bending/or kneeling access for maintenance (removal of front panel) also allows staff to operate controls (800) and for 2 persons to change positions behind screen (1050) - see note 2
400-450
control unit (see note 1)
distance to table varies (see X-ray table data sheet)
2000 (1700)
comfortable space for 3 persons within cubicle (restricted space)
1400 (1150)
space for 2 persons in cubicle (restricted space)
additional space for control unit plus clearance - varies (see note 1)
additional space for location of cassette box (mobile) - varies
space for second person
600 (550)
operator space
800 (600)
space for third person
600 (550)
possible location of cassette box
(400 x 600)
800
200 min. (100) clearance
length of control unit 650-950 (see note 1)
200 min. (100) clearance
screen length varies (see note 3)
800
pref. min. clearance between vertical glazing bars
radiation proof glazing - full screen width (see note 5)

1350 *(1300)*

Preferred minimum: *Restricted minimum (not recommended for general use: see explanatory notes)*

Notes:

1. Size of control unit varies. Unit shown is typical of modern designs where there is a tendency to reduce the size of console by housing more bulky elements elsewhere in the radiodiagnostic room in floor mounted electronic equipment cabinets. These cabinets are normally located in functionally unused areas within the radiodiagnostic room, rather than in the console operators cubicle where priority must be given to staff access and the location of other essential control and display equipment.

2. Passing will not occur during operation of the X-ray tube.

3. Length of protective screen 1600 preferred to accommodate 2 persons side by side 2000 for 3 persons.

4. Displays must be clearly and logically related to their appropriate controls and must not be obscured by operation of the controls. Preferred angle for control/display panel 30° (range 15 - 45). Width of controls should pref. not exceed 700.

5. The radiation proof glazing should preferably be of full screen width to allow unimpeded view of the patient at all times.

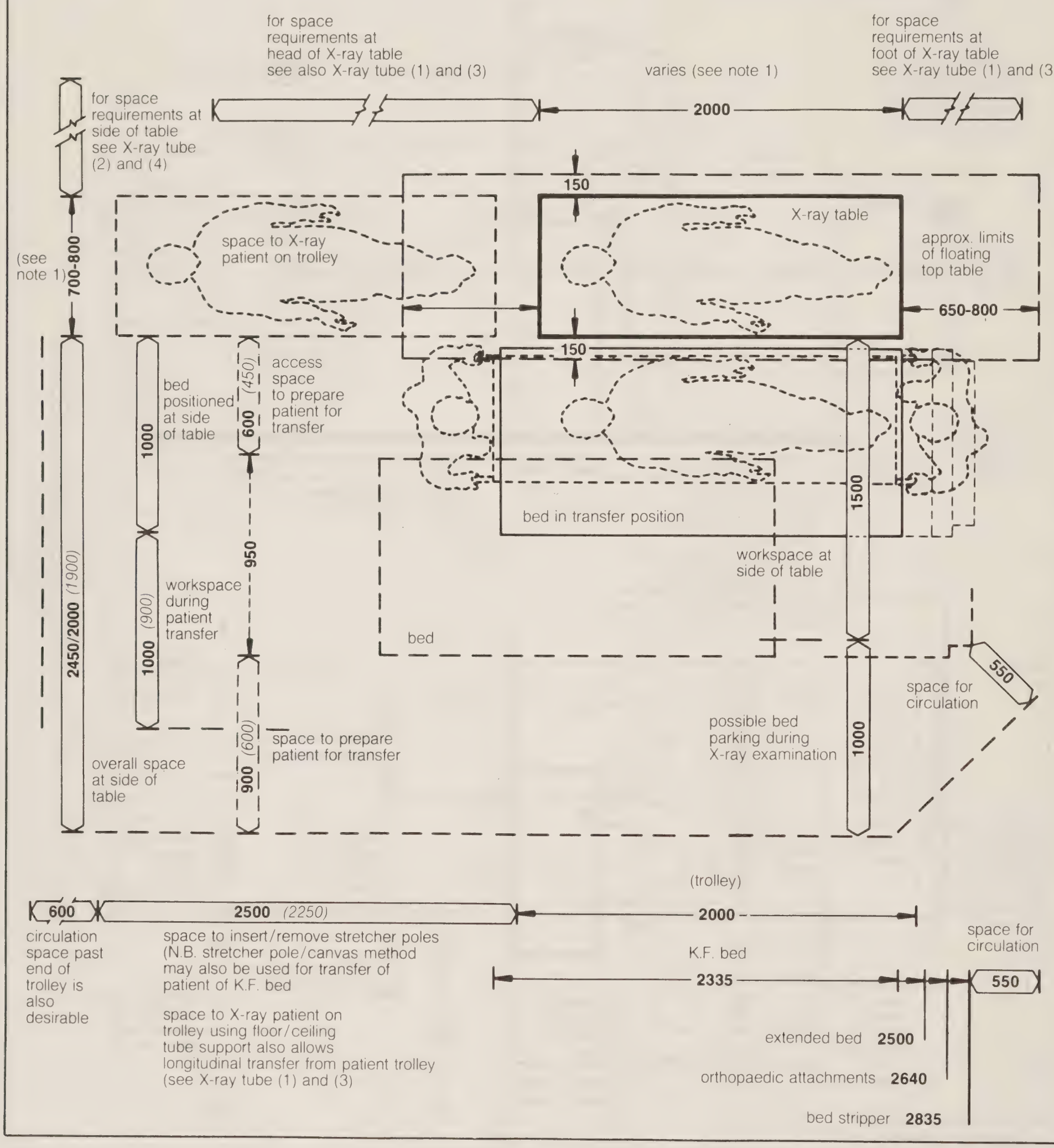
Activities:
Transfer of patient from bed or trolley to X-ray table.

DHSS **Ergonomic data bank:**
Component-user data sheet, not to scale

X-ray table

fixed/sliding/floating/top

Users:
Radiographer and patient.


for space requirements at head of X-ray table see also X-ray tube (1) and (3)
varies (see note 1)
for space requirements at foot of X-ray table see X-ray tube (1) and (3)
2000
for space requirements at side of table see X-ray tube (2) and (4)
(see note 1)
700-800
150
X-ray table
space to X-ray patient on trolley
approx. limits of floating top table
650-800
150
bed positioned at side of table
1000
600 (450)
access space to prepare patient for transfer
bed in transfer position
1500
workspace at side of table
2450/2000 (1900)
1000 (900)
workspace during patient transfer
950
bed
550
space for circulation
possible bed parking during X-ray examination
1000
space to prepare patient for transfer
900 (600)
overall space at side of table
600
2500 (2250)
(trolley)
2000
space for circulation
550
circulation space past end of trolley is also desirable
space to insert/remove stretcher poles (N.B. stretcher pole/canvas method may also be used for transfer of patient of K.F. bed
K.F. bed
2335
space to X-ray patient on trolley using floor/ceiling tube support also allows longitudinal transfer from patient trolley (see X-ray tube (1) and (3)
extended bed 2500
orthopaedic attachments 2640
bed stripper 2835

1350 *(1300)*

Preferred minimum: *Restricted minimum (not recommended for general use: see explanatory notes)*

Notes

1. X-ray table may be fixed, sliding, floating or tilting types - dimensions vary depending on type and manufacturer.

2. Patient transfer
Initially the patient may be positioned parallel to the table with sufficient space between table and trolley/bed to allow an attendant to prepare patient prior to transfer. Space should allow mechanical and other transfer aids to be employed whenever necessary to minimize possible back injury to staff. Commonly the patient is slid across on to and off the X-ray table. A removable transfer mat should be used. Another method is to use stretcher poles and canvas for lifting patient to and from the bed or trolley. In critical cases where manual handling of supine patient is essential, four or more persons lifting will be involved. Space to move clear of bed or trolley will be needed and the full width and length (larger dimension) recommendations are necessary to undertake this manoeuvre safely.

3. Operational experience indicates that overall room widths should preferably not be less than 5 metres.

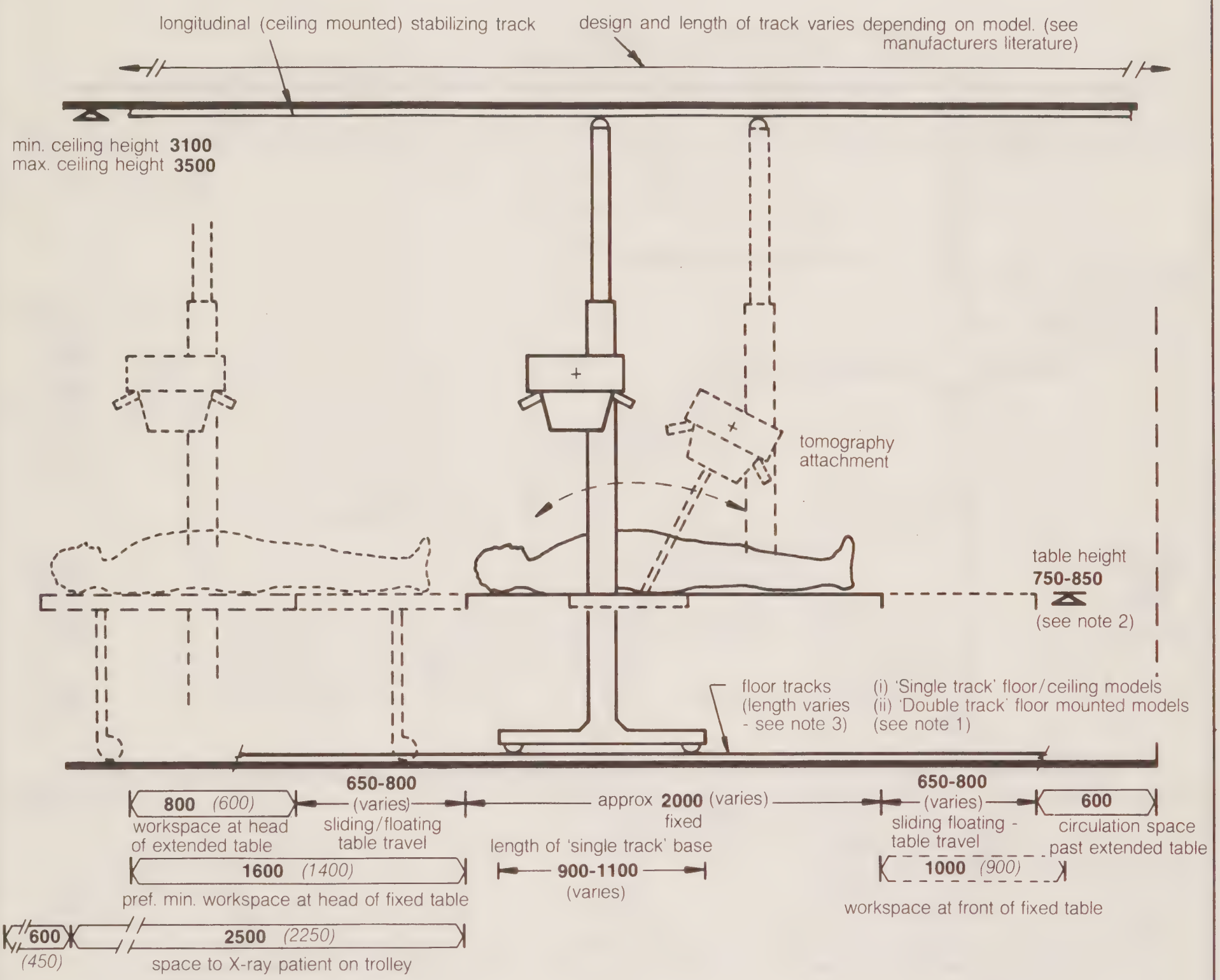
Activities:
General radiodiagnostic procedures

DHSS **Ergonomic data bank:**
Component-user data sheet, not to scale

X-ray tube (1)

Floor/ceiling support
(with fixed or sliding or floating top table)

Users:
Radiographer and patient


longitudinal (ceiling mounted) stabilizing track
design and length of track varies depending on model. (see manufacturers literature)
min. ceiling height 3100
max. ceiling height 3500
tomography attachment
table height
750-850
(see note 2)
floor tracks (length varies - see note 3)
(i) 'Single track' floor/ceiling models
(ii) 'Double track' floor mounted models (see note 1)
800 (600)
workspace at head of extended table
650-800 (varies)
sliding/floating table travel
approx 2000 (varies)
fixed
length of 'single track' base
900-1100 (varies)
650-800 (varies)
sliding floating - table travel
600
circulation space past extended table
1600 (1400)
pref. min. workspace at head of fixed table
1000 (900)
workspace at front of fixed table
600 (450)
2500 (2250)
space to X-ray patient on trolley
workspace/circulation space (see note 5)

1350 *(1300)*

Preferred minimum: *Restricted minimum (not recommended for general use: see explanatory notes).*

Notes:

1. Floor/ceiling columns are preferred to models which are floor mounted only. This is because they are more stable and present less obstruction to staff approach at floor level. (Ceiling mounted columns - see X-ray tube (3) and (4) - should however be employed whenever possible as they give all-round access to the patient and provide greater tube mobility, including lateral exposures from either side of the patient).

2. Table height and patient trolley height should be the same to assist patient transfer.

3. Both floor and ceiling track lengths vary depending on model, manufacturer and type of X-ray table used but are usually both between 4000-5500 long.

4. See also X-ray tube (2) and X-ray table data sheet.

5. Additional space to pass head of patient trolley is desirable. Where this space is not available this procedure will be inconvenient for staff to use.

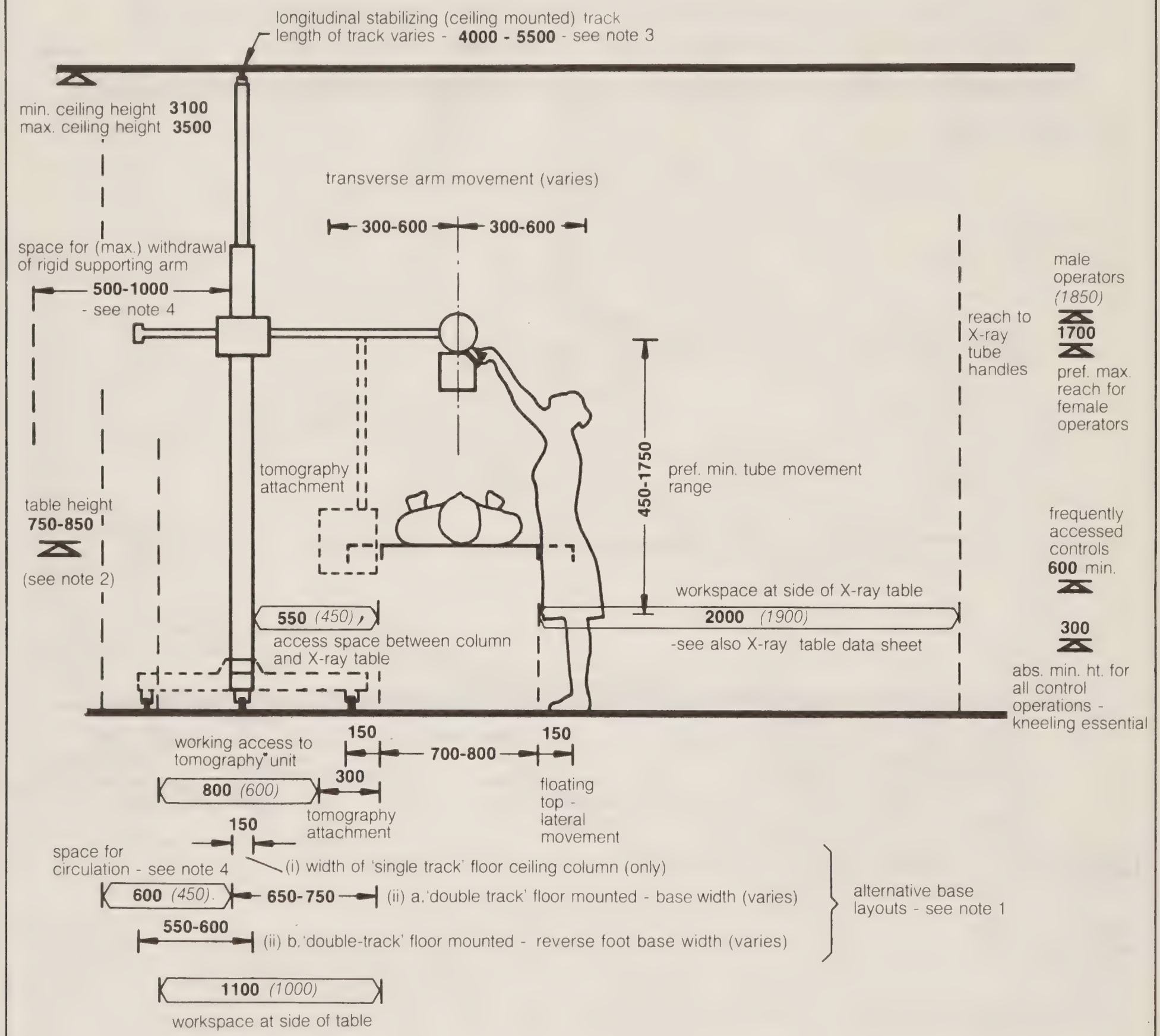
Activities:
General radiodiagnostic procedures

DHSS **Ergonomic data bank:**
Component-user data sheet, not to scale

X-ray tube (2)

Floor/ceiling support
(with fixed or sliding or floating top table)

Users:
Radiographer and patient


longitudinal stabilizing (ceiling mounted) track
length of track varies - **4000 - 5500** - see note 3
min. ceiling height **3100**
max. ceiling height **3500**
transverse arm movement (varies)
300-600
300-600
space for (max.) withdrawal of rigid supporting arm
500-1000
- see note 4
reach to X-ray tube handles
male operators *(1850)*
1700
pref. max. reach for female operators
tomography attachment
450-1750
pref. min. tube movement range
table height
750-850
(see note 2)
frequently accessed controls **600** min.
workspace at side of X-ray table
2000 *(1900)*
-see also X-ray table data sheet
550 *(450)*
access space between column and X-ray table
300
abs. min. ht. for all control operations - kneeling essential
working access to tomography unit
150
700-800
150
800 *(600)*
300
tomography attachment
floating top - lateral movement
150
space for circulation - see note 4
(i) width of 'single track' floor ceiling column (only)
600 *(450)*
650-750
(ii) a. 'double track' floor mounted - base width (varies)
550-600
(ii) b. 'double-track' floor mounted - reverse foot base width (varies)
alternative base layouts - see note 1
1100 *(1000)*
workspace at side of table

1350 *(1300)*

Preferred minimum: *Restricted minimum (not recommended for general use: see explanatory notes).*

Notes:

1. Floor/ceiling columns are preferred to models which are floor mounted only. This is because they are more stable and present less obstruction to staff approach at floor level. (Ceiling mounted columns - see X-ray tube (3) and (4) - should however be employed whenever possible as they give all-round access to the patient and provide greater tube mobility, including lateral exposures from either side of the patient).

2. Table height and patient trolley height should be the same to assist patient transfer.

3 Both floor and ceiling track lengths vary depending on model, manufacturer and type of X-ray table used but are usually both between 4000-5500 long.

4. Clearance required for max. withdrawal of tube rigid supporting arm will usually be greater than basic space required for circulation past column support.

5. See also X-ray tube (1) and X-ray table data sheet.

6. Operational experience indicates that overall room widths should preferably not be less than 5 metres.

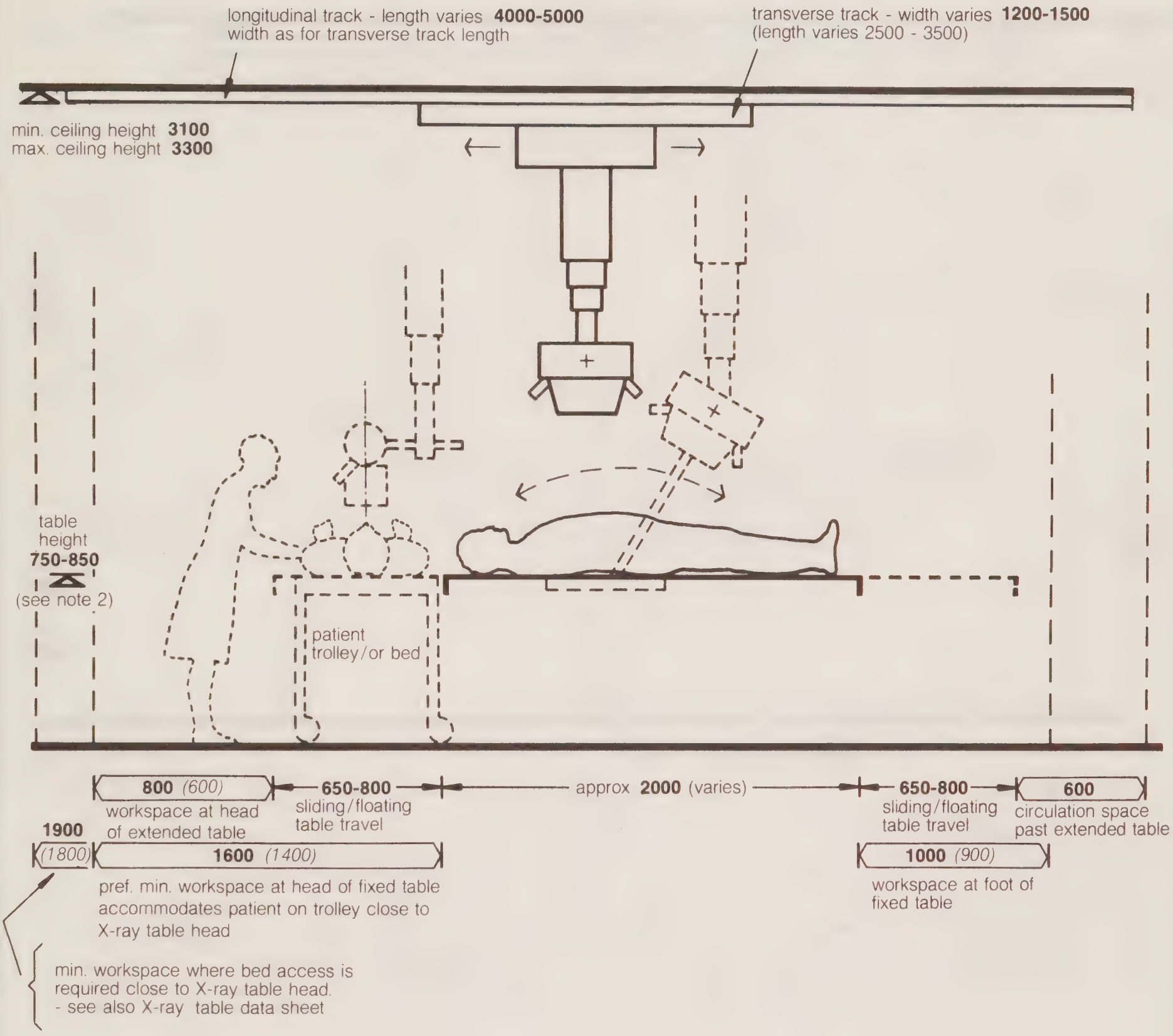
Activities:
General radiodiagnostic procedures

DHSS **Ergonomic data bank:**
Component-user data sheet, not to scale

X-ray tube (3)

Ceiling mounted support
(with fixed, or sliding, or floating top table)

Users:
Radiographer and patient


longitudinal track - length varies **4000-5000**
width as for transverse track length
transverse track - width varies **1200-1500**
(length varies 2500 - 3500)
min. ceiling height **3100**
max. ceiling height **3300**
table height **750-850**
(see note 2)
patient trolley/or bed
800 *(600)*
workspace at head of extended table
650-800
sliding/floating table travel
approx **2000** (varies)
650-800
sliding/floating table travel
600
circulation space past extended table
1900 *(1800)*
1600 *(1400)*
pref. min. workspace at head of fixed table accommodates patient on trolley close to X-ray table head
1000 *(900)*
workspace at foot of fixed table
min. workspace where bed access is required close to X-ray table head.
- see also X-ray table data sheet

1350 *(1300)*

Preferred minimum: *Restricted minimum (not recommended for general use: see explanatory notes).*

Notes:

1. Ceiling mounted columns are generally preferred, because they leave the floor free of obstructions, give all-round access to the patient and provide full mobility for the tube over a required area, including lateral exposures from either side of patient.

2. Table height and patient trolley height should be the same for ease of patient transfer.

3. See also X-ray tube (4) and X-ray table data sheet.

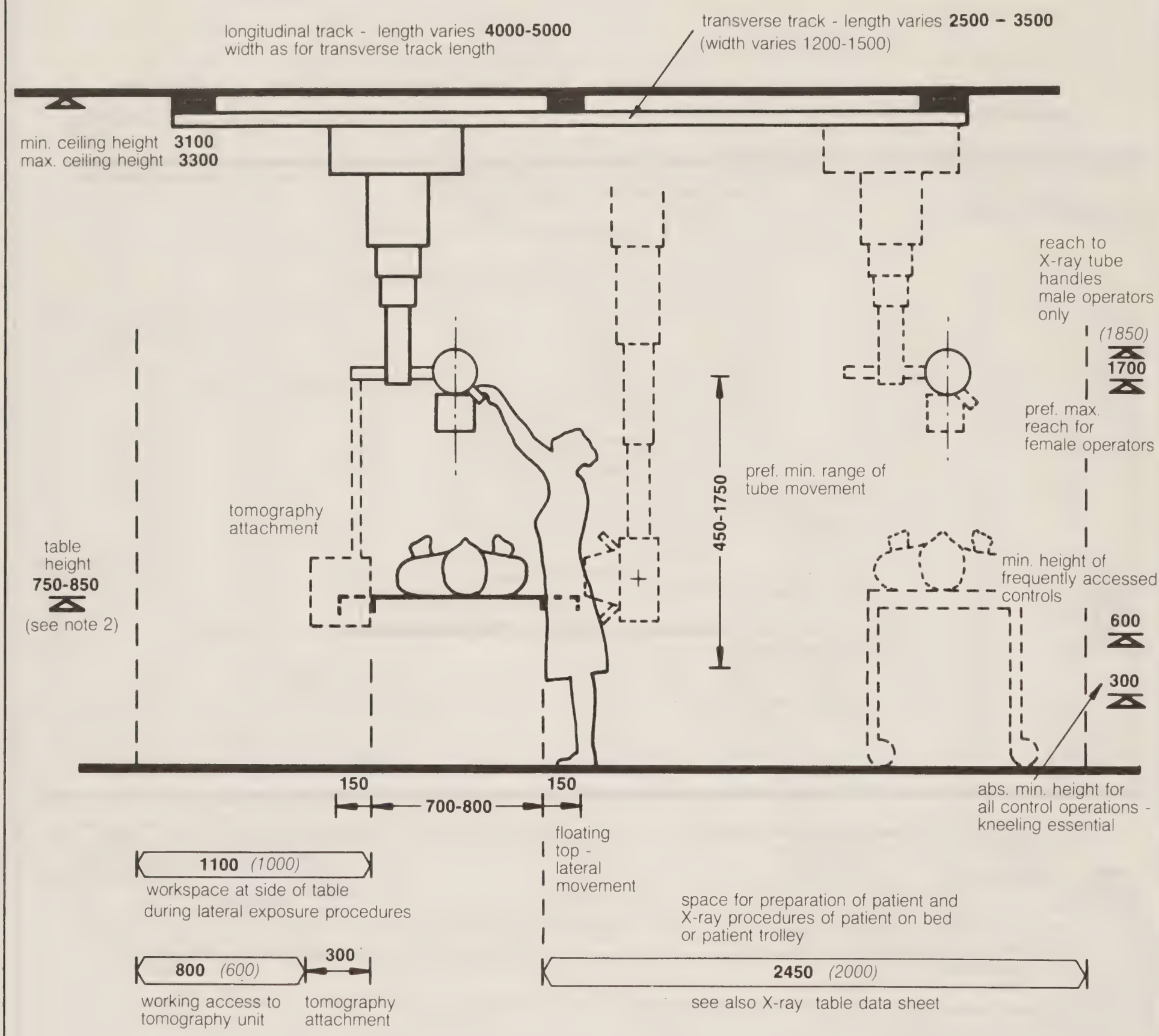
Activities:
General radiodiagnostic procedures

DHSS **Ergonomic data bank:**
Component-user data sheet, not to scale

X-ray tube (4)

Ceiling mounted support
(with fixed, or sliding, or floating top table)

Users:
Radiographer and patient


longitudinal track - length varies **4000-5000**
width as for transverse track length
transverse track - length varies **2500 – 3500**
(width varies 1200-1500)
min. ceiling height **3100**
max. ceiling height **3300**
reach to X-ray tube handles male operators only
(1850)
1700
pref. max. reach for female operators
tomography attachment
pref. min. range of tube movement
450-1750
table height **750-850**
(see note 2)
min. height of frequently accessed controls
600
300
150
700-800
150
abs. min. height for all control operations - kneeling essential
floating top - lateral movement
1100 *(1000)*
workspace at side of table during lateral exposure procedures
space for preparation of patient and X-ray procedures of patient on bed or patient trolley
800 *(600)*
300
working access to tomography unit
tomography attachment
2450 *(2000)*
see also X-ray table data sheet

1350 *(1300)*

Preferred minimum: *Restricted minimum (not recommended for general use: see explanatory notes).*

Notes:

1. Ceiling mounted columns are generally preferred, because they leave the floor free of obstructions, give all-round access to the patient and provide full mobility for the tube over a required area, including lateral exposures from either side of patient.

2. Table height and patient trolley height should be the same for ease of patient transfer

3. See also X-ray tube (3) and X-ray table data sheet.

4. Operational experience indicates that overall room widths should preferably not be less than 5 metres.

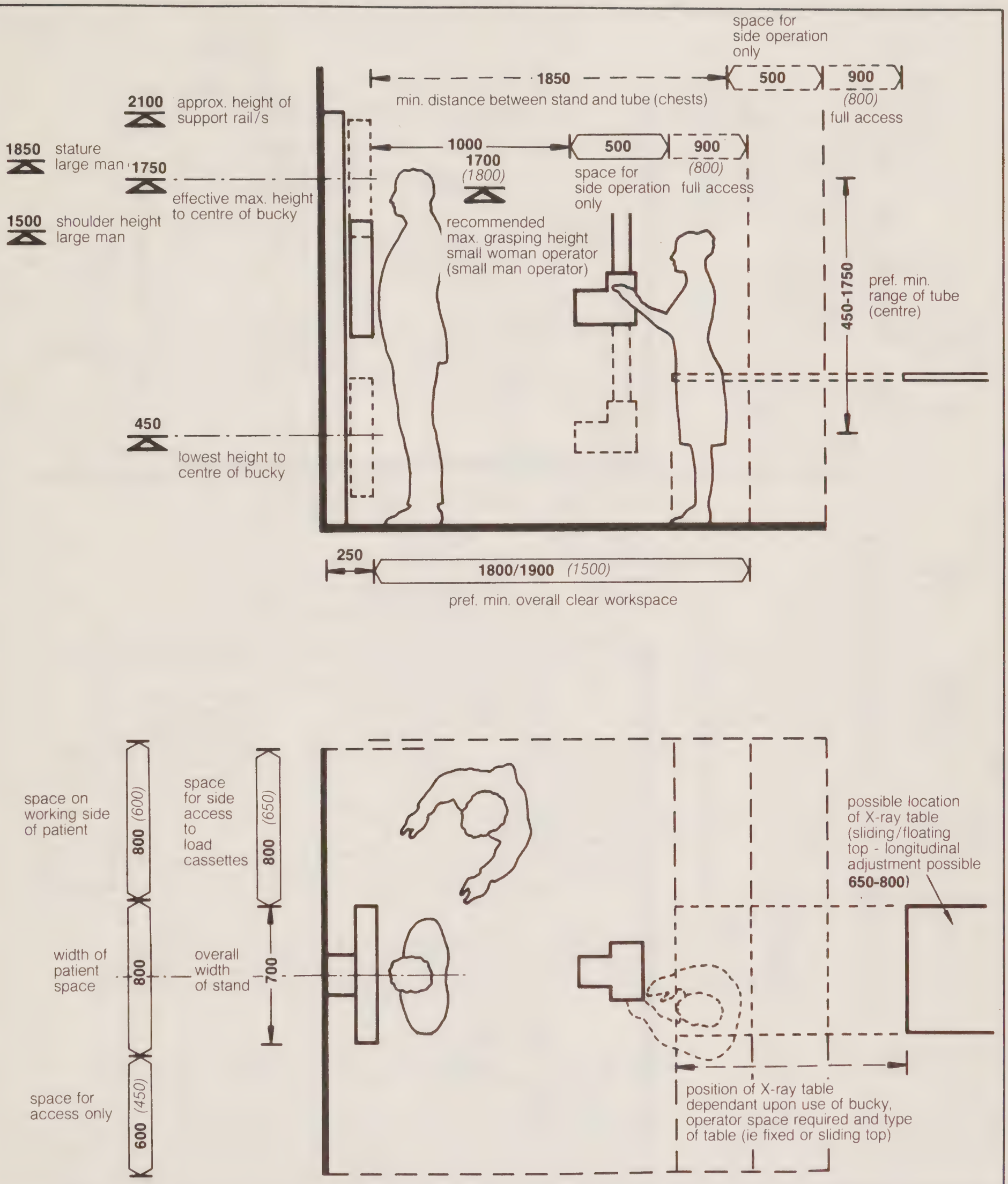
Activities:
General radiodiagnostic procedures. See also Bucky Stand (2), (3) and (4) data sheets.

DHSS **Ergonomic data bank:**
Component-user data sheet, not to scale

Bucky Stand (1)

Wall mounted/vertical

Users:
Radiographer and patient



1350 *(1300)*

Preferred minimum: *Restricted minimum (not recommended for general use: see explanatory notes)*

Notes:

1. Examinations may be undertaken with the patient standing.
2. Workspace shown relates to 1000 distance between tube and stand.

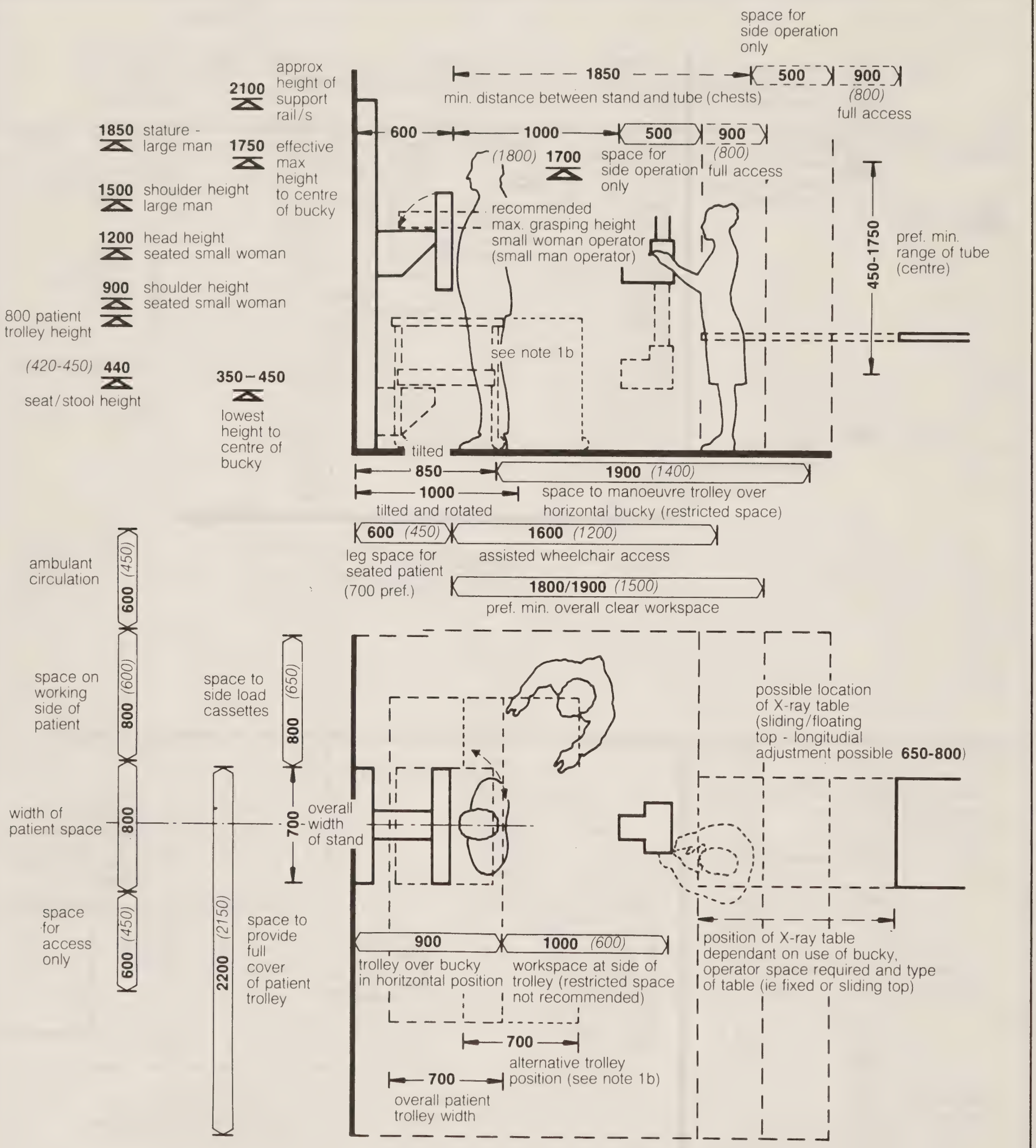
Activities:
General radiodiagnostic procedures. See also Bucky Stand (1), (3) and (4) data sheets.

DHSS **Ergonomic data bank:**
Component-user data sheet, not to scale

Bucky Stand (2)

Wall mounted/universal

Users:
Radiographer and patient



1350 *(1300)*

Preferred minimum: *Restricted minimum (not recommended for general use: see explanatory notes)*

Notes:

1. Examinations may be undertaken with patient either:-
   a) standing
   b) seated on stool or chair
   c) seated on edge of patient trolley
   d) lying on patient trolley with bucky in horizontal position under trolley
2. Workspace shown relates to 1000 distance between tube and stand.

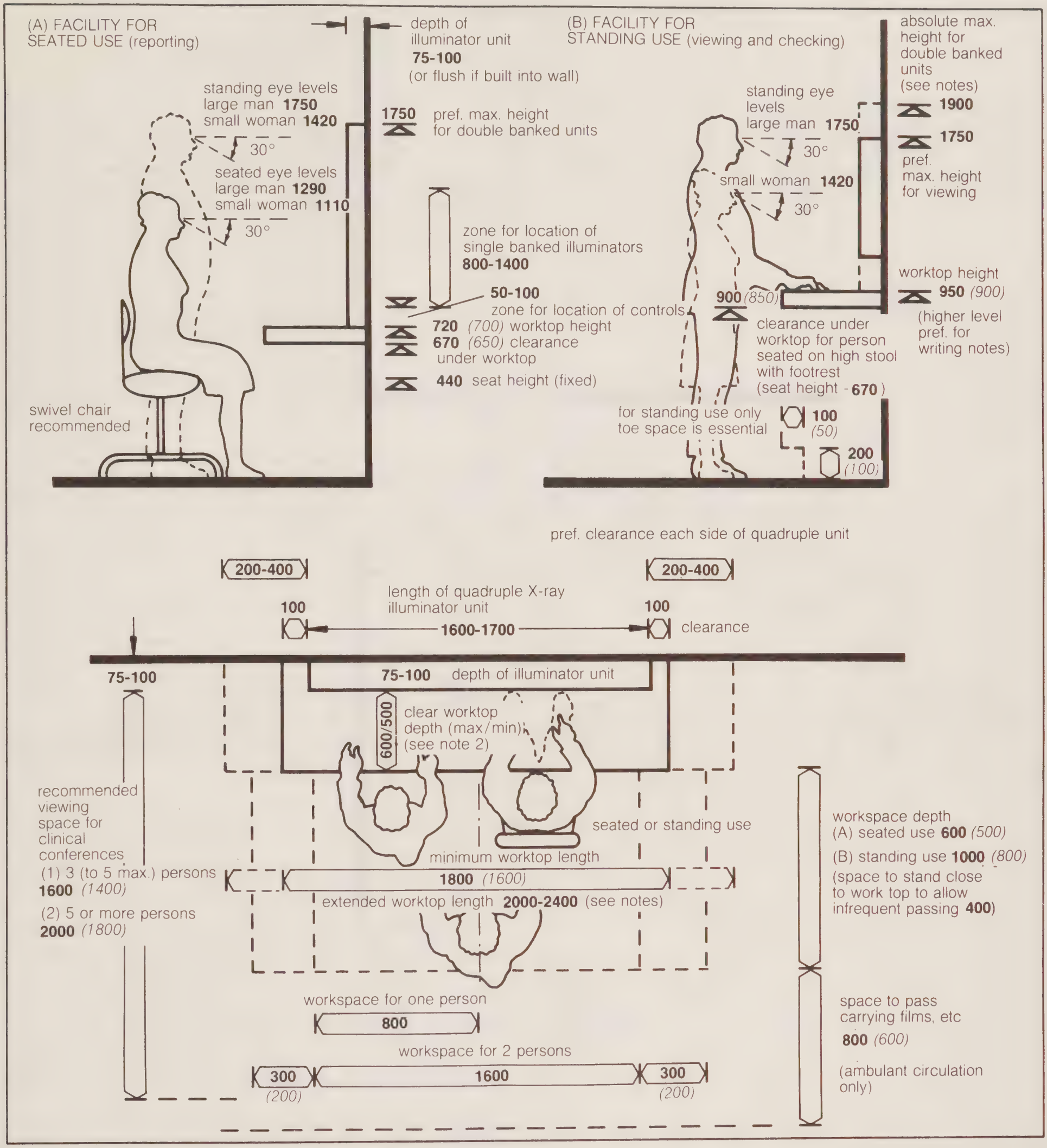
Activities:
Viewing and reporting on X-ray films using single or double banked quadruple wall mounted X-ray illuminators.

DHSS **Ergonomic data bank:**
Component-user data sheet, not to scale

X-ray Illuminators

(reporting and viewing workstations)

Users:
Male and female staff



1350 *(1300)*

Preferred minimum: *Restricted minimum (not recommended for general use: see explanatory notes)*

Notes:

1. Double banked illuminators are recommended for convenience of use, but do present some design difficulties when positioned over a high worktop for standing use, where the upper viewers can be positioned too high for a large proportion of female staff also shorter male staff. It is therefore preferable that double banked illuminators be installed over worktops at the lower level of 900 above floor level (or designed for seated use). Even so the design of illuminator must be very carefully selected to ensure that the viewing area does not exceed the absolute limit of 1900 above floor level. (eg. to facilitate this, switches should be located either at the side of the units or incorporated into the design of the worktop to maximise vertical space immediately above worktop which is available for viewing.

2. Close viewing distance is 450 mm therefore bench depth should be minimised. However, where large X-ray films and envelopes are handled, a minimum depth of 600mm is desirable. All worktops should therefore be 600mm deep (measures to front edge of illuminator).

3. A worktop width of 1600 provides 2 basic workstations only. For more efficient working additional holding space (pref. 400 mm) should be available to one side of each workstation. Optimum worktop length is therefore 2400 mm.

4. Recommended spaces for general viewing are based on focal length (acuity) of 1000 for older staff.

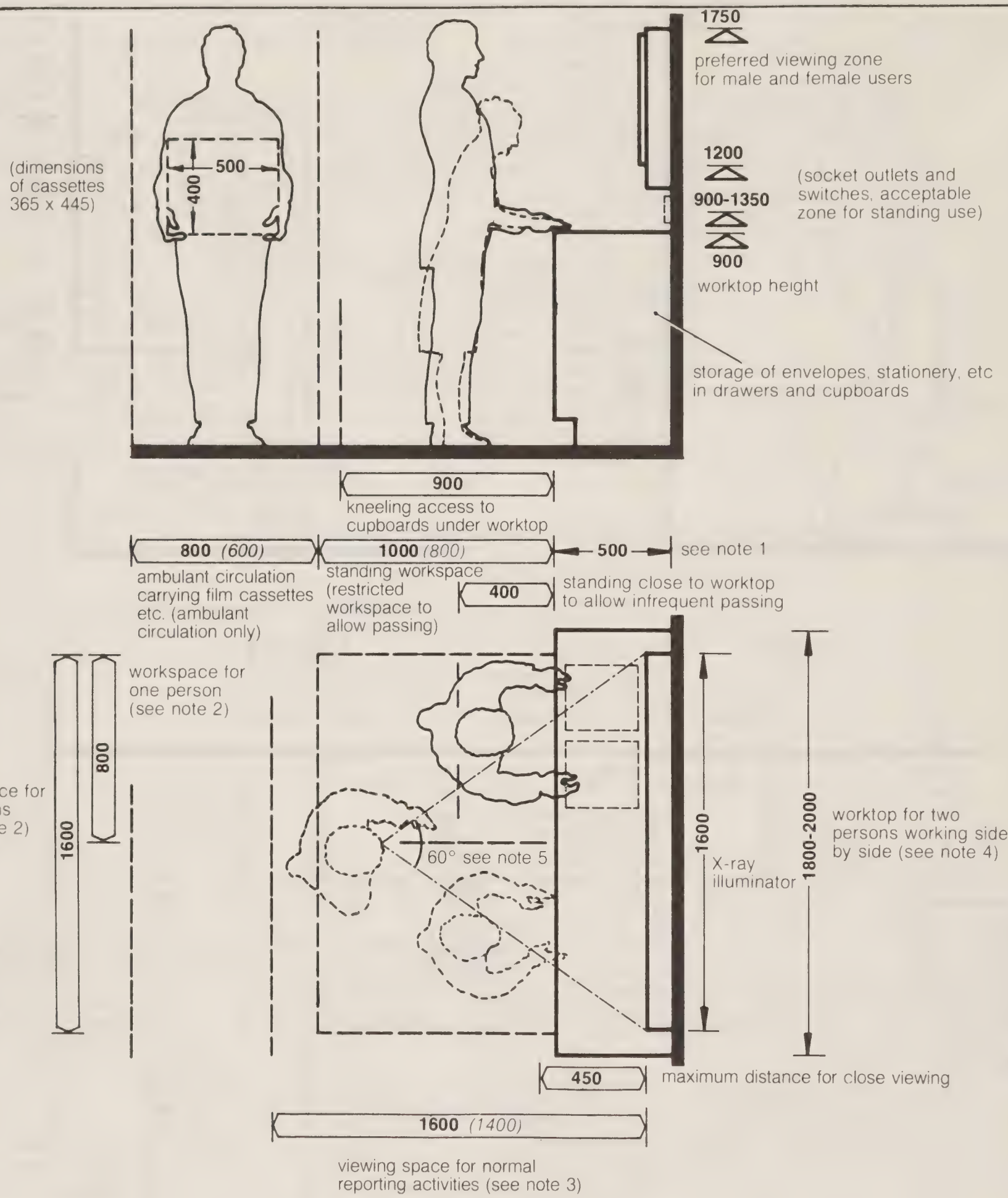
Activities
Viewing and checking and reporting on X-ray films.

DHSS **Ergonomic data bank:**
Component-data sheet, not to scale

X-ray worktop

with wall mounted X-ray illuminators (viewing areas)

Users
radiography staff (male and female)



1350 *1300)*

Preferred minimum *Restricted minimum (not recommended for general use: see explanatory notes)*

Notes:

1. Bench depth is very critical. 500 minimum is required to hold large cassettes, films and envelopes. Any increase in depth would impede reach and approach to X-ray viewers for critical viewing. Therefore it is preferable that bench length be increased to provide bench-top space for incidental small items associated with film sorting and collating.

2. Worspace width (800 for one person, 1600 for two persons) provides unimpeded space for arm and hand movements during simple manipulative worktop tasks. Below elbow height (800), space required for access to worktop can be reduced to 600 and 1400 respectively (eg a low radiator or other projection could be accommodated within the lower periphery of the workspace shown).

3. This recommendation is based on the acuity (focal length of 1000) of older staff. Where large clinical conferences occur this space should be increased from 1600 (1400) to 2000 (1800).

4. A 1600 worktop gives 800 per work-station. 800 will accommodate 2 large film/cassettes only, and additional space of 100-200 is preferred to accommodate associated items (see note 1).

5. Recommended max. head movement when comparing 4 films.

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